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AN OPERATIONS RESEARCH MODEL FOR LOCATING AREA VOCATIONAL SCHOOLS.

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THE PURPOSES OF THIS STUDY WERE TO DETERMINE THE MAJOR CHARACTERISTICS OF A PREDICTIVE MODEL FOR USE IN LOCATING AND ESTABLISHING AREA VOCATIONAL SCHOOLS, DEVELOP THIS PREDICTIVE MODEL, AND ANALYZE THE STATISTICAL SIGNIFICANCE OF THE FACTORS COMPRISING EACH OF THE CHARACTERISTICS. A LITERATURE REVIEW AND CONFERENCES WITH STATE AND LOCAL EDUCATIONAL LEADERS WERE USED TO IDENTIFY THE MAJOR ELEMENTS FOR THE MODEL. A SURVEY OF 94 SCHOOLS IN 14 STATES PROVIDED DATA WHICH WAS ANALYZED AND CATEGORIZED INTO THE MODEL'S ELEMENTS. A JURY OF 30 EDUCATORS RANKED THE ELEMENTS ON RELATIVE IMPORTANCE. THE THREE MAJOR CHARACTERISTICS OF THE MODEL WERE POTENTIAL ENROLLMENT, JOB OPPORTUNITIES FOR GRADUATES, AND FINANCIAL SUPPORT. THE MODEL WAS APPLIED TO TWO COMMUNITIES IN NEW MEXICO TO PREDICT WHETHER OR NOT THEY COULD SUCCESSFULLY SUPPORT AN AREA VOCATIONAL SCHOOL. WHEN THE DISCRIMINANT FUNCTION MODEL WAS APPLIED TO THE SAMPLE OF EXISTING AREA VOCATIONAL SCHOOLS, THE RESULTS COINCIDED WITH CLASSIFICATIONS MADE BY STATE VOCATIONAL DIRECTORS AND THE INVESTIGATOR IN 86.17 PERCENT OF THE INSTANCES. SUCH MODELS CAN BE USED BY EDUCATORS AS ANALOGUES REPRESENTING PROCESSES OR SYSTEMS UNDER STUDY. (EM)

An Operations Research Model for Locating Area Vocational Schools

by

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NEW MEXICO STATE UNIVERSITY
LAS CRUCES, NEW MEXICO 88001

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U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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BY

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March 1967

PREFACE

The passage of Public Law 88-210 by the Federal Congress focused attention on the problem of locating and establishing area vocational schools.

New Mexico did not have any area vocational schools prior to the passage of the Vocational Act of 1963. A search of the literature and plans from other states revealed that there were many different methods of approach to this problem.

An attempt has been made in this research to set up a model and criteria which, when followed, can predict with reasonable accuracy the success of an area vocational school.

This study has been quite valuable to us in getting enabling legislation passed by our State Legislature.

Dr. M. G. Hunt
State Director of
Vocational Education
Santa Fe, New Mexico

March 13, 1967

ACKNOWLEDGMENTS

The writer is indebted to many professors and associates who have provided extensive knowledge, sound criticisms, and recommendations during the planning and development of this study.

Special appreciation must be extended to Dr. M. G. Hunt, New Mexico Director of Vocational Education and Mr. Gene Schrader, Director of the Research Coordinating Unit for funding the study and for their perceptive suggestions.

The efforts and contributions of committee members far exceeded normal expectations and the writer is grateful for this assistance.

The cooperation of Computer Center and Duplicating Service personnel were very beneficial in expediting the study. Finally the writer must express special gratitude to Mrs. Sylvia Boudreau for her patience and dedication in performing well the many varied secretarial tasks involved in the study, and to Mrs. Linda McLellan for her perseverence in preparing the final copy under the pressure of time.

VITA

The writer, John Elmo Uxer, is a native of New Mexico. He attended public elementary and secondary schools in eastern New Mexico and was graduated from the Dora High School in June, 1942. His higher education was interrupted by the advent of World War II but after some three years of service in the United States Navy, during which he was graduated from the United States Navy Radio Operator's and Technician's School, he enrolled at New Mexico State University (then New Mexico College of Agriculture and Mechanic Arts).

He received the Bachelor of Science degree in June, 1950, the Master of Arts degree in January, 1951, and the Education Specialist degree in June, 1962.

His public school experience includes one year at House, one year at Carlsbad, seven years at Artesia, and four years at Jal, all in New Mexico. He has taught Vocational Agriculture, Agricultural Science, Chemistry, Biology, English, Mathematics, and Reserve Officer Training Corps courses at the junior high and high school levels. Additionally, he served as Director of Guidance and Counseling, Director of Instruction, and Superintendent of Schools.

His higher education experience includes instruction of off-campus graduate and undergraduate courses from two universities in psychology, guidance and psychological services, curriculum, and educational administration. He also served one year as a graduate research assistant at New Mexico State University. During the current year he has taught educational administration courses as a resident member of the graduate faculty of New Mexico State University.

ABSTRACT

The purpose of the study was to develop a predictive model for use in locating area vocational schools.

Increasing emphasis on vocational education as evidenced by the Vocational Education Act of 1963 and other federal and state legislation have produced considerable pressure upon states to establish area vocational schools. The relatively high cost of vocational education precludes the establishment of area vocational schools in every community. Thus, a scientific method of locating such schools is demanded. Modular methods of explication have been utilized effectively by researchers in other disciplines and this method was considered appropriate for this study.

A search through the professional literature related to industrial engineering and vocational education, and personal conferences with state and local educational leaders helped identify the major elements of a predictive model. A jury of thirty educators was utilized to rank the major elements in order of relative importance, and responses were tested statistically for consensus of opinion by Kendall's Test of Concordance.

Factors comprising each major element of the model, which were subject to variation, were identified and enumerated on a questionnaire. Most of the responses to the questionnaire items were obtained during site visits by the investigator to the fourteen states selected for the study. A total of ninety-four area vocational schools comprised the sample. A review of the programs of other states indicated that most terminal-type vocational education was being conducted at the post-high school level through area vocational schools. The most common factors considered by officials from other states in locating area vocational schools were high school enrollment in the area, total population in the area, administrative structure, and financial support capability. Factors least often considered were geographic radius of the area vocational school district, anticipated first year enrollment in the vocational school, and distance to another vocational school.

Thirteen factors were selected for statistical analysis in the development of the model. The discriminant analysis procedure was used to analyze the data because it provided (1) a method for determining significant differences between characteristics of successful and less successful area vocational schools; (2) a means of classification of individual schools into one of the groups based on a knowledge of these characteristics; and (3) a model which will permit educators to predict whether or not a particular district could successfully support a vocational school.

In instances where a decision cannot be made on the basis of a single variable, a discriminant analysis permits the classification of individuals into two or more categories based on a linear function of a number of independent variables each of which provides some indication as to the groups in which an individual should be placed.

After the initial fieldwork was completed each of the area vocational schools sampled were classified as successful or less successful by the respective state directors of vocational education and the investigator. A discriminant analysis revealed that the two groups can be differentiated from one another on the basis of a linear combination of the characteristics studied.

The findings imply that (1) other states have not used multivariate, statistical procedures in locating area vocational schools; (2) the correlation of programs offered with skills needed was low in some areas; (3) the majority of graduates are placed in the immediate geographic vicinity; and (4) broad, long-range plans are needed to properly implement a vocational education program.

The evidence of this study further implies conclusively that the multivariate approach to decision making results in more objective and more economical decisions than most other methods. The discriminant analysis procedure used in this study allows this kind of approach.

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CHAPTER I

INTRODUCTION

Increasing emphasis on vocational and technical education and the dramatic increase in dependence upon technically trained employees demands systematic and comprehensive examination of many factors relating to vocational and technical education. School dropouts, persons displaced because of automation, and unemployed adults are able to become more productive through additional training. Jobs which require higher technical skills are available to them as trained individuals. An examination of these and other factors such as tax bases, employment potentials, and diversified programs help establish the feasibility of vocational-technical education programs.

The provisions of the Vocational Act of 1963, Public Law 89-10, The Elementary and Secondary Education Act, in addition to previous federal legislation, have marked implications for vocational and technical training as funds are provided in increased amounts, for the first time, to staff and equip such programs. A recent statewide study of occupational needs for vocational and technical education in New Mexico indicates vast needs for vocational and technical education.[1] This study indicated requirements for over 68, 000 vocationally trained personnel during the next five year period. These findings imply that over 13, 000 persons must be trained annually to keep pace with presently identified needs. Should additional needs arise, the burden of training would increase.

Although an opportunity for vocational-technical education should be available to every person who can profit by such educational programs, the higher costs preclude establishment of comprehensive programs in every town. Consequently, judicious decisions must be made in geographically locating vocational and technical education schools.

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[1] James D. McComas and Darrell S. Willey, Occupational Needs for Vocational and Technical Education, Bureau of Educational Research, New Mexico State University Publication Number 8 (University Park: New Mexico State University, 1966).

Quantitative, reliable procedures such as the discriminant analysis technique used in this study may be employed in order to assist educators to make better decisions regarding educational problems.

I. THE PROBLEM

The study was to develop a predictive model for use in locating and establishing area vocational schools. Although the specific application of the study was to area vocational schools, the techniques used in developing a model which takes into consideration the relevant factors in making such a decision might well be applied to similar decisions.

II. SPECIFIC OBJECTIVES OF THE STUDY

The specific objectives of the study were (1) to determine the relative importance of the potential enrollment,or input, market for graduates, and financial support for area vocational schools; (2) to identify the determining factors associated with input potential, market for graduates, and financial support for area vocational schools; (3) to develop a quantitative criterion that would include the factors affecting input potential, market for graduates, and financial factors for area vocational schools; (4) to statistically verify the opinions of state directors of vocational education and the investigator concerning the successfulness of area vocational schools; (5) to apply the proposed model to selected area vocational schools which were rated as successful and less successful; and (6) to survey and describe selected area vocational school characteristics beyond those included in the model.

III. ASSUMPTIONS

The assumptions underlying this study were that (1) favorable attitudes would exist in areas indicated by the model as logical locations of area vocational schools; (2) adequate legislation exists or would be enacted to enable the creation and operation of area vocational schools; (3) the percentage of people seeking training in area vocational schools would follow approximately the national and regional patterns; and (4) population figures of the states as listed in the 1960 United States Census are still reasonably representative.

IV. LIMITATIONS OF THE STUDY

The variables included in this study were limited to those deemed relevant to the location of vocational schools by educators with experience in this area as well as those identified through a comprehensive study of state programs of vocational education.

The model developed was based on a representative sample of ninety-four schools in fourteen states.

V. NEED FOR THE STUDY

In October, 1963, New Mexico's Governor Jack M. Campbell called a statewide conference concerning vocational and technical education in New Mexico. He outlined five objectives of the conference, one of which was, "What next steps must be taken to implement a comprehensive State program of vocational education in New Mexico?"[2] It is in response to this question that the present study was undertaken.

Although a number of studies had previously been conducted relative to vocational-technical education, the passage of the Vocational Education Act in 1963 markedly accelerated vocational education activities in order to capitalize upon its provisions. It is apparent, as noted in the subsequent findings described in this study, that the successful location and establishment of area vocational schools is related to the combined, interrelated and cumulative effect of a number of factors. Because no study evaluating such an effect could be located, it was concluded by the New Mexico State Department of Education personnel, New Mexico State University personnel, and the investigator that such a study was necessary in order to maximize the use of limited construction and operational funds.

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[2] The Governor's Conference on Vocational and Technical Education (called by Governor Jack M. Campbell, 1963), p.4.

New Mexico has taken initial steps in implementing technical and vocational programs. Legislation enacted during the 1963 session of the Legislature provided for further development of technical and vocational programs and junior colleges. One act provides for the creation, financing, supervision, and dissolution of junior college districts and prescribes the powers and functions of such institutions. Another act authorizes creation of technical and vocational institutes in any county; provides for formation, financing, supervision, and dissolution of technical and vocational institutes; and prescribes the powers and functions of such districts.[3]

The New Mexico State Board for Vocational Education has designated three area vocational schools. These include the Technical-Vocational Institute at Albuquerque, the Northern New Mexico State School at El Rito, and the New Mexico Junior College at Hobbs.

Three state universities in New Mexico were operating two-year technical programs: Eastern New Mexico University, Highlands University, and New Mexico State University. The University of New Mexico offered two-year programs for dental assistants and in data processing, and two-year general secretarial courses were offered at Eastern New Mexico University and New Mexico State University. New Mexico State University also offered a two-year data processing course. Eastern New Mexico University also had two-year programs for medical secretaries and legal secretaries. Five licensed practical nurse programs were in operation at five cities in the State.[4] New Mexico State University initiated a two-year Agricultural Institute in September, 1966.

Although these programs represent progress in offering technical and vocational education to New Mexico residents, they are by no means sufficient to meet the needs of the State. A greater than average high school dropout rate prevails in some parts of the State where vocational and technical education programs are not available; other students desire vocational or technical education but are located in areas not served by such programs. Employers have expressed a desire for vocationally or technically trained employees.[5] The distribution of population in New Mexico and other states of similar population-density characteristics necessitates careful study in order to provide maximum educational opportunities within the financial resources of the State. Therefore, it seems mandatory that a systematic analysis of the needs of the State relative to its existent capabilities be accomplished in order to establish criterion for the location and establishment of vocational and technical schools.

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[3] Division of Vocational and Technical Education, Bureau of Adult and Vocational Education, United States Department of Health, Education and Welfare, Summary Report of Vocational-Technical Program Development by States (Washington: Government Printing Office, 1965), p. 29.

[4] Ibid., p. 30.

VI. DEFINITION OF TERMS

Area Vocational School

"Area Vocational School" is defined as a publicly supported school which offers as its curriculum or part of its curriculum vocational-technical education, training, or retraining. This training is available to persons who have completed or left high school and are preparing for the labor market; persons who are attending high school and who will benefit from such education or training but do not have the necessary facilities available in the local high schools; persons who have entered the labor market but are in need of upgrading or learning skills; and persons who, due to academic, socio-economic, or other handicaps are prevented from succeeding in regular vocational or technical education programs.

Discriminant Analysis

"Discriminant Analysis" refers to a multivariate procedure used to predict the group membership of individuals on the basis of a set of attributes measured as continuous variables.[6]

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[5] McComas and Willey, loc. cit.

VII. METHOD OF INVESTIGATION

Following a review of literature related to the location of industrial and engineering facilities, a series of personal conferences were held with state and local educational leaders for the purpose of identifying the major characteristics influencing the location and establishment of area vocational schools.

Descriptions of the major characteristics identified were submitted to a jury of thirty nationally recognized educational leaders who were asked to rank them in the order of relative importance. One-hundred per cent of the jury members responded to the request, although one jury member declined to rank the characteristics. The questionnaire listing the major characteristics is included in Appendix A and the jury members are listed in Appendix B.

Kendall's statistical test of concordance was applied to the ranking of the major characteristics to determine the degree of consensus among judges. The calculation of Kendall's coefficient of concordance is shown in Appendix C.

Factors which were subject to variation were identified pertaining to each of the major characteristics and placed on a questionnaire for convenience in gathering and tabulating responses. Additional questions which were considered relevant were included in the questionnaire. However, records of area vocational schools were not complete enough to answer some of the questions. The questionnaire is included in Appendix D.

Fourteen states were selected by the investigator in conference with New Mexico State Department of Vocational Education and New Mexico State University Department of Educational Administration personnel as sources of nationally and regionally representative data. Further, ninety-four area vocational schools were chosen based upon dispersion, ability of school personnel to provide required data, and willingness to cooperate in providing data. The data were recorded on the questionnaire during site visits by the investigator. States in which area vocational schools comprising the sample are located are shown in Appendix E.

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[6] William W. Cooley and Paul R. Lohnes, Multivariate Procedures for the Behavioral Sciences (New York: John Wiley and Sons, Incorporated, 1962), p. 6.

Data analyses were accomplished on Control Data Corporation Model 3300 and International Business Machines Model 1130 computers located at the New Mexico State University Computer Center.

The discriminant analysis statistical procedure was chosen to analyze the data because it provided a method of determining whether or not there were significant differences between the quantitative characteristics of the successful and less successful area vocational schools, and for the classification of area vocational schools into these two groups. This procedure also provided for the calculation of a probability of the correctness of the classification.

A weighted score for each variable or factor was calculated during the discriminant analysis. These factors were combined into a total score that permitted classification of schools into two categories of success. Additional discriminant function scores were determined for combinations of the factors: anticipated first year area vocational school enrollment; grade nine through twelve enrollment in high schools within the area, projected five-year grade nine through twelve enrollment in high schools within the area, and total population within the area; for the factors grade nine through twelve enrollment in high schools within the area, projected five-year grade nine through twelve enrollment in high schools within the area, total population within the area, and categories of skills needed within the area; and for the factors, anticipated first-year area vocational school enrollment, grade nine through twelve enrollment in high schools within the area, projected five-year grade nine through twelve enrollment in high schools within the area, total population within the area, categories of skills needed within the area, and categories of programs offered during the first year of operation.

The schools were classified into two groups. Group I comprised the area vocational schools classified as less successful and Group II comprised those schools classified as successful. Each of the area vocational schools comprising the sample were classified into either Group I or Group II based upon each combination of factors, or variables, described in the method of investigation. The classifications of the schools are listed in Appendix F.

Procedures for applying the model and examples of the application were developed in the study. Further, recommendations for the application of the model were developed.

VIII. SETTING FOR THE STUDY

Implication of Federal Provisions

Although prior to 1917 several provisions had been made for federal aid for educational programs, primarily under the direction of institutions of higher education, the Smith-Hughes Act of that year was the first Act providing appreciable support for vocational programs.

Whereas many provisions for federal aid to education are directly related to national defense, the national program for vocational education was established as a peacetime measure to assist and stimulate a growing economy.[7] A cooperative endeavor between the federal government and the states was initiated only after intensive consideration and investigation by Congress. A Commission on National Aid to Vocational Education was created by Congress in 1914. A report of the findings of their Commission led to the enactment of the Smith-Hughes Act in 1917.[8]

Congress subsequently passed several acts to further develop vocational education. The George-Reed Act of 1929, the George-Ellzey Act of 1934, and the George-Deen Act of 1936 were successively superceded, eventually culminating in the George-Barden Act of 1945. Benefits of the

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[7] United States Department of Health, Education, and Welfare, Office of Education, Vocational Education in the Next Decade (Washington: Government Printing Office, 1961), p. 9.

[8] Ibid.

Smith-Hughes Act were extended to Puerto Rico in 1931. The George-Barden Act was amended to include the Virgin Islands in 1950 and Guam in 1956. Additionally, the Eighty-Fourth Congress amended the George-Barden Act authorizing an annual grant, for four years, for area vocational programs.

Under the provisions of the Smith-Hughes Act and subsequent Acts extending these provisions, a number of comprehensive programs of vocational education have been developed.[9] Although much was accomplished, the need for broader support was evident and the Vocational Act of 1963 was enacted to help satisfy this need. One section of this Act specifically provides for the formation and operation of area vocational schools.

As vocational education emerges in American education and as it gains momentum, five questions presented by Norman Harris need to be resolved. These questions are:

1. Where, within the economy and within the occupational structure, are the jobs?
2. What are the entry jobs for youth and what age limitations are placed on them?
3. Is apprenticeship a bridge between school and work, or is it a barrier between youth and jobs?
4. What does the technological revolution tell us about education and training requirements?
5. Where should occupational education be offered--in special schools, or in the mainstream of American education?[10]

Most Vocational programs have been located in high school settings; however, there is a question as to their appropriate location. A current popular belief that most vocational programs belong in a post-high school setting was expressed in the Sixty-Fourth Yearbook, Vocational Education, published by the National Society for the Study of Education. The chairman of the committee made this statement in the concluding chapter, "One would say that the future of vocational education belongs to the post-high school institution."[11]

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[9] Roy W. Roberts, Vocational and Practical Arts Education (New York: Harper and Row Publishers, 1963), p. 131.

[10] Norman C. Harris, "Redoubled Efforts and Dimly Seen Goals," Phi Delta Kappan, Volume 64 (April, 1965), p. 361.

Background for Vocational Education in New Mexico

General. New Mexico is, geographically, the fifth largest state in the Union with an area of 121,666 square miles. The State is divided into thirty-two counties, the largest of them being comparable in size to the smaller states.

New Mexico has a semiarid climate. The rainfall varies from six inches or less per year in the southwestern valleys to about thirty or more inches in the northern mountain areas. The dry climate attracts many individuals who are seeking improvement in health. This factor is influential in attracting certain kinds of industry and equally influential in the rejection of the area by others. Future area vocational school locations and offerings may be affected by this factor.

History. All three of the major characteristics affecting the successful location and establishment of area vocational schools, input potential, market for graduates, and financial support, are influenced by long-standing traditions. Whether or not students who have dropped out of high school, or even those who have graduated from high school without a marketable skill, will attend a vocational school; whether or not graduates of a vocational school will leave a community to seek a job for which they have received training; and whether or not taxpayers will accept the additional responsibility of financing vocational education are influenced to a degree by the historical and social evolution of the State.

According to historians, the present State of New Mexico was inhabited some twenty thousand years ago by the Folsom man and his predecessor, the Sandia man. Later, these primitive people were replaced by the pueblo-type Indians who built their homes in the cliffs. The very complex civilization developed by these people stands over today as a monument to their culture.[12] As a result of this close-knit, traditional culture, change has been slow and tedius.

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[11] Melvin L. Barlow, A Platform for Vocational Education in the Future (Vocational Education, 64th Yearbook, Part I, National Society for the Study of Education, Chicago: University of Chicago Press, 1965), p. 287.

Public Institutions. Except for that offered in senior colleges, post-high school vocational education is available at three locations. All three are operating on an area basis. The Northern New Mexico State School at El Rito is open to students from within the State. The Albuquerque Technical-Vocational Institute is available primarily to students living within the Bernalillo School Tax District but nonresident students may attend by paying a specified tuition fee. The New Mexico Junior College has been designated as an Area Vocational School and will serve primarily the surrounding area encompassing Lea County.[13] Additionally, several vocational programs have been conducted under the Manpower Development and Training Act.

Legislation. The New Mexico State Board for Vocational Education has not adopted a set of criteria for the establishment of area vocational schools although this Board outlines its policy in the construction of area vocational schools in the State Plan for the Administration of Vocational Education Under the Federal Vocational Education Acts.[14]

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[12] Virginia R. Keehan, "Implications for Leadership in the State Department of Education Based on a Study of Attitudes of Educators Concerning Guidance and Personnel Services in New Mexico" (Unpublished Doctor's Thesis, The University of Colorado, 1954), pp. 10-11.

[13] Loyd R. Hughes, The Area Vocational School: A Summary Report (Resident Instruction Series Number 8, New Mexico State University: Department of Agricultural and Extension Education, 1966), p. 31.

[14] New Mexico State Board for Vocational Education, New Mexico State Plan for the Administration of Vocational Education Under the Federal Education Acts (Santa Fe: State Department of Education, (1964), p. 31.

Except for the Northern New Mexico State School which operates by direct state appropriations just as state colleges and universities, area vocational schools in New Mexico are operated under the provisions of the 1963 "Junior College Act"[15] and the "Technical and Vocational Institute Act".[16]

The Junior College Act defines a "junior college" as "a public educational institution which shall provide not to exceed two (2) years of training in the arts, sciences, and humanities beyond the twelfth grade of the public high school curriculum, or in lieu of such training or in addition thereto, not to exceed two (2) years of a vocational and technical curriculum and appropriate courses of study for persons who may or may not have completed the twelfth grade of public high school."[17]

The board of the junior college has the power to fix tuition and fee rates for resident and nonresident students of the district, to accept federal aid, to purchase, hold, and sell and rent property and equipment, and to promote the general welfare of the institution for the best interest of educational service to the people of the junior college district.[18]

The junior college board may borrow money for the purpose of constructing, purchasing, remodeling and equipping buildings and utility facilities, or purchasing grounds, exclusive of dormitories and stadia. To carry out these purposes, the board may issue general obligation bonds. These bonds are subject to approval by the State Board of Educational Finance and approved at an election by a majority of the qualified electors voting on the issue. The bonds may not create a total indebtedness in excess of three per cent of the assessed valuation of taxable property within the junior college district.[19]

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[15] New Mexico, Statutes (1963), 73-33-1 to 73-33-18.

[16] New Mexico, Statutes (1963), 73-34-1 to 73-34-12.

[17] New Mexico, Statutes (1963), 73-33-2.

[18] New Mexico, Statutes (1963), 73-33-9.

[19] New Mexico, Statutes (1963), 73-33-13.

An election must be held every six years and may be conducted every two years to determine the mill levy for the operation and maintenance of the junior college. Taxes levied for operation and maintenance may not exceed five mills. Levies, assessments, and collections authorized for junior college district financing are made at the same time and in the same manner as levies, assessments, and collections for ad valorem taxes for school districts are made.[20]

The Technical and Vocational Institute Act defines a "technical and vocational institute" as "a public education institution which shall provide not to exceed two years of vocational and technical curriculum and, in addition, some appropriate courses in the arts and sciences."[21]

A technical and vocational institute district may be formed upon the petition of qualified electors who have paid a property tax during the preceding year in any school district or group of districts, equal to the number of ten per cent of the vote cast for governor in each school district in each county, in the last preceding general election.[22]

The petition is then filed with the State Board of Education which immediately makes a survey of the proposed district to determine the need for the proposed institute and the prospects for its adequate support. Three criteria have been established by the Legislature and must be met before the State Board will approve the petition. These three are:

1. The proposed district boundaries must be geographically suitable.
2. The existence of adequate school population and other factors must indicate the proposed institute will develop to the point where it will serve an enrollment of at least two hundred full-time student equivalents.
3. The financial position of the proposed district must be adequate to provide the necessary supporting funds for

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[20] New Mexico, Statutes (1963), 77-33-14.

[21] New Mexico, Statutes (1963), 77-33-2.

[22] New Mexico, Statutes (1963), 77-34-3.

> current operations, including maintenance and direct charges, and the necessary capital outlay for physical plant and equipment.[23]

Upon approval of the State Board of Education, each board of the school district or districts shall present the proposal for the creation of a technical and vocational institute district on a separate ballot at the time of the next school board election or at any election called for that purpose. If the majority of the qualified ad valorem taxpaying electors, voting in the election, vote in favor of establishing a technical and vocational institute district, the district is legally established.[24]

The governing board of the technical and vocational institute district is composed of the board of the initiating school district if one school is involved. If more than one public school district is involved, the board is composed of one member delegate from each participating governing board. In the event there is an even number of participating school districts, the boards of all participating districts jointly appoint an additional member who serves as a member at large. The powers and duties of the technical and vocational institute district parallel those of the junior college district.[25]

Private Institutions. A survey of the privately-owned vocational schools in the State of New Mexico was conducted during July and August, 1966, by Advanced Cybernetics (AVC), Incorporated, Albuquerque, New Mexico.

The objectives of this survey were to obtain data on each privately-owned vocational school in the State, and to compile the data in usable form to assist the State Department of Vocational Education in formulating short-and-long-range plans for vocational training.[26]

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[23] Ibid.

[24] New Mexico, Statutes (1963), 73-34-4.

[25] New Mexico, Statutes (1963), 73-34-5.

This survey showed that 1,562 students were currently enrolled in privately-owned vocational schools during 1966. Of this number, 521 were enrolled in cosmetology schools in ten cities. Almost one-half (225) of the cosmetology school enrollees were attending schools in Albuquerque.

Other characteristics of the privately-owned cosmetology schools were:

1. The anticipated enrollment in the fall of 1966 was 646.
2. Present facilities could accommodate 1,170 students.
3. Dropout rates range from 2 per cent to 25 per cent with an average dropout rate of 8 per cent.
4. Only twenty-two male students were enrolled in cosmetology schools.
5. All students were either high school graduates or had completed an equivalent course.
6. Tuition fees ranged from $195 to $325. The length of the course was not reported in the survey.
7. All schools depended on customer fees to subsidize the cost of student training.[27]

Business schools accounted for 840 of the 1,562 students enrolled in privately-owned vocational schools. Of this number, 510 were enrolled in data processing and computer programming schools in Albuquerque, and 46 were enrolled in miscellaneous schools such as electronics, drafting, automobile mechanics, and bartending, all in Albuquerque. One hundred and four students were enrolled in business courses in privately-owned vocational schools throughout the rest of the State.

Vocational Education Needs in New Mexico. A comprehensive statewide occupational study was undertaken in November, 1964 for the State Board for Vocational Education by Darrell S. Willey and James D. McComas of New Mexico State University.

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[26] E. D. Nunns, "A Survey of the Privately-Owned Vocational Schools in New Mexico" (Albuquerque: Advanced Cybernetics (AVC), Incorporated, 1966), p. 1. (Mimeographed).

[27] *Ibid.*, Annex I to Appendix B.

Thirty-one population centers were selected for the study providing a geographically representative sample in terms of population, and businesses and industrial diversification.[28] A similar study of Las Cruces, New Mexico had been completed by Dowell H. Williams in 1963.

The thirty-one towns surveyed included: Alamogordo, Albuquerque, Artesia, Belen, Carlsbad, Clayton, Cloudcroft, Clovis, Deming, Espanola, Farmington, Gallup, Grants, Hobbs, Las Vegas, Lordsburg, Los Alamos, Los Lunas, Lovington, Portales, Raton, Roswell, Ruidoso, Santa Fe, Santa Rosa, Silver City, Socorro, Springer, Taos, Truth or Consequences, and Tucumcari.

The implications of this study for area vocational schools are reflected in the total needs in various occupational areas. The total needs were derived from a summation of vacancies, additional needs within the next five years, and turnover. The occupational needs of the thirty-one towns surveyed plus Las Cruces are summarized in Appendix G.

Demographic Information. If Silver City, Las Cruces, Albuquerque, Gallup, Farmington, Santa Fe, Clovis, Artesia, Alamogordo, Socorro, and Hobbs were each circumscribed by a line fifty miles from the center, approximately 95 per cent of the total population of New Mexico would be included. Chief exceptions include substantial pockets of population in Colfax, Quay, Union, Guadalupe and Sierra Counties. If, however, the boundaries were moved out to a distance of sixty miles from each of the towns, most of the population of Quay and Sierra Counties would be included resulting in the inclusion of substantially more than 95 per cent of the total population of New Mexico.

A study by Ralph L. Edgel and the University of New Mexico Bureau of Business Research designed to provide estimates of the number of people who might be expected to live in New Mexico and its individual counties during the next four decades indicates that an estimated 1,208,000 people will live in New Mexico by 1970, and 1,630,000 by 1980.[29]

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[28] McComas and Willey, op. cit., p. 12.

Based upon normal circumstances and discounting the possibilities of unexpected industrial location, 78.44 per cent of the population will be concentrated in eleven counties in 1970. These counties are: Bernalillo, Chaves, Curry, Dona Ana, Eddy, Lea, McKinley, Otero, San Juan, Santa Fe, and Valencia.[30]

The summary in Appendix H shows the Bureau of Business Research estimates of New Mexico State population by counties by the year 2000.

Implications of Selected State's Programs for the Location of Area Vocational Schools

Review of the programs in existence and those planned in other states indicates that most terminal-type vocational education is being conducted at the post-high school level although many states have developed cooperative programs with vocational schools in order to accommodate appropriate high school students. The descriptions of programs for selected states will identify and establish relevance of factors or variables, to area vocational school location.

Arizona. All post-high school, technical, supervisory, and other post-high school vocational education programs are located in junior colleges in Arizona. An exception is adult education which may be offered by high schools or junior colleges where there is a demonstrated need.

The Arizona Legislature passed a law in 1964 which authorizes two or more high school districts or one or more high school districts and a junior college district to cooperate in offering vocational programs that neither could alone afford or justify, but to date these schools have not been developed.

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[29] Ralph L. Edgel, "Projections of the Population of New Mexico and Its Counties to the Year 2000," New Mexico Business, (July-August, 1965), p. 10.

[30] Ibid., p. 14.

The state Board for Vocational Education pays the entire per capita cost for instruction of out-of-district students enrolled in vocational programs.[31]

Colorado. A survey of course enrollments in Colorado's junior colleges shows that less than twenty per cent of the students were enrolled in the vocational-technical curriculum, although one of the primary functions of the junior college is to provide training for employment upon completion of the program. The Colorado State Department of Education conducted a feasibility study of possible locations of area vocational schools in the State and designated fourteen area vocational school districts. These area vocational school districts vary in size from 16,335 square miles for the district in the northwest corner of Colorado to an area just large enough to include Denver in central Colorado. The high school enrollments in grades ten, eleven, and twelve in these districts vary from 1,371 to 19,154, and the district assessed valuations range from $69,000,000 in area district number thirteen in south central Colorado to $1,150,000,000 in the Denver area.

There seems to have been no direct attempt made to determine the relative significance of various factors in the establishment of area vocational schools.[32]

Georgia. A system of twenty-nine state and area vocational-technical schools is being developed in Georgia. By September, 1963, twelve area vocational-technical schools and two state vocational-technical schools were in operation. Of the fifteen additional area schools which have been approved by the State Board of Education, four were under construction by the end of 1963.[33]

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[31] Personal Correspondence of the Investigator, letter from J. R. Cullison, State Director of Vocational-Technical Education, October 13, 1966.

[32] State Board for Vocational Education, Area Schools (Denver: State Board for Vocational Education, 1966).

[33] United States Office of Education, Vocational and Technical Education: A Review of Activities in Federally Aided Program, Fiscal Year 1963 (Washington: Government Printing Office, 1964), p. 25.

In locating and establishing these area vocational-technical schools, the Georgia State Board of Education applied twelve criteria, although the relative importance of the criteria was not determined. The criteria used by the Georgia State Board of Education were:

1. The attendance area must contain not less than 60,000 in total population.
2. A radius of approximately thirty miles shall be considered the attendance area for an area vocational school. One-half the distance between two locations of less than thirty miles shall be considered as the attendance area.
3. The combined enrollment of high school grades nine through twelve in the attendance area shall be not less than 3,000.
4. No more than one school shall be constructed in any approved location.
5. Schools must be located in centers where there is a large and growing population, never in an area where the population is decreasing.
6. Schools shall be located where there is a concentration or expansion of industry.
7. Local school systems must provide a site of not less than ten acres, and 50 per cent of the cost of architectural fees, construction and equipment costs.
8. Local school systems within the attendance areas must have *ongoing* programs in the vocational areas as a nucleus to build a complete area vocational-technical program.
9. The local school system must make an official commitment to provide maintenance and operation of the building.
10. Local school systems cannot charge students a tuition fee.
11. The school shall provide a minimum of eight training areas.
12. Instructional programs shall be designed for occupational competency leading to immediate employment, but *not* leading to a baccalaureate degree.[34]

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[34] Georgia State Department of Education, *Criteria for Approval of Locations for Area Vocational-Technical Schools* (Atlanta: State Department of Education, undated), p. 1.

Idaho. A philosophy has been developed in Idaho, stating that broad-range vocational education classes should be available to all residents in the State. Experience with the vocational programs in Idaho suggests that the success of area vocational schools depends, to a great extent, upon the location of the school. Also, if the maximum number of persons are to derive the maximum benefit from dollars spent, the programs must be located in areas of high population density. Idaho's experience has also shown that the greater percentage of those attending area vocational education schools live within fifty to seventy-five miles of the school.

Although Idaho statutes allow area vocational schools to be associated with a college or university or to be established as an independent state-operated school, the Idaho State Board for Vocational Education has ruled that, insofar as possible, area vocational education schools in Idaho should be associated with a junior college or state educational institution. This action resulted from the belief that area schools associated with a college or univeristy have distinct advantages for students since those who desire may avail themselves of academic courses offered by the school during the evening or other hours outside scheduled vocational education classes.

The average total population per area vocational school district was

The average total population per area vocational school district was 111,199 ranging from 74,749 persons in the North Central area to 212,371 persons in the Southwestern area. High school enrollment per area vocational school district averaged 6,174. The North Central area had the least number of high school students with 3,590. The largest enrollment, 11,175, occurred in the Southwestern area.

In Idaho, state-owned and operated area vocational schools are either administered by existing state institutions or operate independently. In area schools administered by existing institutions, the State Board for Vocational Education reimburses 100 per cent of building, instructional costs, equipment, supplies, maintenance of vocational equipment, and administration and supervision directly related to the vocational program. All costs of operation of a state-owned and operated independent area vocational school are supplied by the State Board for Vocational Education.

The State also participates in the support of area vocational schools operating under the jurisdiction of local boards. State Board participation in the construction of area vocational school facilities at public education institutions which operate under the jurisdiction of a local board is limited to fifty per cent. State Board participation is contingent upon a written agreement between the local board and the Idaho State Board for Vocational Education stipulating that the buildings constructed through the use of public vocational funds will be used in accordance with specified policies and the provisions of the Vocational Education Act of 1963, and/or subsequent legislation and that there will be no reduction of present usable facilities.

Proposals for the establishment of area vocational schools in Idaho must contain assurance that the following criteria can be satisfactorily achieved:

1. There must be reasonable documented assurance that the employment opportunities will exist for the graduates in the community, the State or elsewhere, in the occupation or occupations for which training is given.

2. There must be reasonable assurance of initial and continuing enrollment for the proposed programs and that enrollment practices will give consideration to the intention of the student to enter employment in the occupation or occupations for which training is given, and to the ability of the student to profit from the instruction as determined by adequate testing and guidance.

3. The school must seek out and use the advice and counsel of persons who are representative of the industry or occupation for which training is given.

4. The proposed instructional program must be based upon an analysis of the occupation for which training is given.

5. Time allowance for the proposed vocational education program must be sufficient to attain the objectives for the program as determined by an occupational analysis.

6. Adequate initial facilities and equipment must be available for the total proposed program or plans give evidence that the equipment and facilities will be supplemented according to a reasonable schedule.

7. There must be reasonable assurance that the administrative, supervisory, and instructional staff will be

adequate in both quantity and quality and that the policies of the school are conducive to the development and maintenance of the proposed program.

8. The cost of the proposed vocational education program must be realistic in light of training to be offered and the number of students to be reached.

9. There must be assurance from the school that such records and reports of program operation, as are required by the State Board, will be submitted to the State Board within designated time limits.[35]

Kansas. Prior to the passage of a Vocational-Technical Act, introduced as Senate Bill Number 438, in 1963, most of the vocational education in Kansas secondary schools was centered around about two hundred programs of vocational agriculture located primarily in the smaller communities of the State.[36] Following the passage of this Act, the State Board for Vocational Education began the establishment of a State system of area vocational-technical schools.[37]

The Bill provided for two methods of administrative organization. The board of control of any area vocational-technical school [illegible] board of the school district in which the school was to be located, or, the alternative method, a board consisting of one or more representatives from each of the boards of the cooperating districts subject to the approval of the state superintendent of public instruction. The second method proved most acceptable in those cases where the vocational school was supported with tax levies from cooperating districts.[38]

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[35] State Board for Vocational Education, Area Vocational Education Schools in Idaho (Boise: State Board for Vocational Education, undated).

[36] Statement made by John W. Lacey, Former State Supervisor of Area Vocational-Technical Schools in Kansas at Las Cruces, New Mexico, January, 1965.

[37] Ibid.

[38] Ibid.

The Bill empowers the local school districts to levy two mills in support of an area vocational school subject to the vote of the patrons at the annual school meeting. Enrollment fees were to be established by the governing body of the area school and charged for persons coming from cooperating districts against the two mill levy until this levy was used up and then an additional charge would be made to the school district.[39]

Senate Bill Number 438 of the 1963 session of the Legislature of the State of Kansas, in establishing the criteria for the location and establishment of area vocational-technical schools, outlined a minimum of eight factors which must be considered:

1. Concentration of population within a reasonable community service area.
2. Total school enrollments in grades one through eight, and in grades nine through twelve, separately.
3. Number of high school graduates within the area to be served.
4. Probability of sustained growth in school enrollments within such area.
5. Identification of educational services needed within the area.
6. Local interest and attitudes toward the program within the area.
7. Ability of the area to contribute to the financial support of the program.
8. Consideration of the area in relation to other requests for programs of vocational-technical training to prevent overlapping or duplication of educational services.[40]

In a statement of policies and principles pertaining to the establishment of area vocational-technical schools under the provisions of Senate Bill Number 438, the Kansas Board for Vocational Education said that, with the possible exception of the Kansas City and Wichita school districts, each request for an area school should represent the cooperative endeavor of a sufficient number of school boards to assure a large enough unit to appropriately contribute to a state system of vocational-technical schools.

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[39] Ibid.

[40] Senate Bill Number 438, State of Kansas, June, 1963.

Not more than twenty such schools, which will most equitably serve all youth and adults of the State as a whole, should be established.[41]

The policies of the Kansas Vocational Education Board also state that each request for an approvable area school should show evidence of a continuing need of fifteen or more persons to be trained each year in a minimum of five skilled occupational areas served by the curricula.[42]

Although Senate Bill Number 438 provided eight criteria for the location and establishment of area vocational schools, the State Board for Vocational Education established three basic criteria for use in this determination. The first criterion concerned the geographic areas. The Board decided that with the exception of two or three larger urban communities, no application would be considered which did not include a geographic area of more than one county. Population density regulated the required number of participating counties. The second major consideration was the size of the tax base of the area to be served. The Board assumed that federal legislation would provide a portion of the necessary assistance for the vocational schools in their programs. The Board also assumed that local communities would have to provide about fifty per cent of the cost. Therefore, a tax base large enough to yield a considerable amount of money would have to be considered in location decisions. The third basic criterion was the population represented by the potential area.[43]

Although the foregoing criteria were used in determining area vocational school location, in no case was the size of the geographic area or the minimum tax base or the total population specifically defined. Further, no effort was made to determine the relative significance of the factors.[44]

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[41] State Board for Vocational Education, Statement of General Policies and Principles (Topeka, Kansas: State Department of Vocational Education, 1963), p. 1.

[42] Ibid.

[43] Lacy, loc. cit.

[44] Ibid.

During the twelve months following the passage of Senate Bill 438, eight schools were approved as area vocational-technical schools, seven of which began operation on September 1, 1964; the eighth began operation some several months later. Two additional locations were approved in 1965 and began operation that fall.[45]

Montana. Montana vocational education officials are, at the present time, studying the development of area vocational schools in that State. They state that Montana is somewhat unique in that they have an average of five persons per square mile and a population of only 730,000 people.

According to a report by an official of the State Department of Public Instruction, they, at the present time, have not developed criteria based on either population or assessed valuation for the establishment of area vocational schools. This official stated that they are very much interested in the possibility of applying the model developed through the present study to the State of Montana.[46]

North Dakota. The North Dakota State Board for Vocational Education is completing a manpower study of training and retraining needs in North Dakota. This study also includes such factors as trends in population and the need for a system of area vocational schools. At the present time there is only one vocational-technical school in North Dakota which is located in the extreme southeastern part of the state. This State is contemplating the establishment of a system of area vocational schools based upon their study. The North Dakota Research Coordinating Unit, in cooperation with the State Board for Vocational Education, will determine the curricula for the advancement of area vocational schools. At the time of this writing, this document was still some three to four months away. Therefore, it cannot be summarized in this study.[47]

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[45] Division of Vocational and Technical Education, Bureau of Adult and Vocational Education, United States Department of Health, Education, and Welfare, Summary Report of Vocational-Technical Program Development by States (Washington: Government Printing Office, 1965), p. 14.

[46] Personal Correspondence of the Investigator, letter from Max H. Amberson, October 11, 1966.

Oklahoma. Joint Resolution Number 520 was adopted by the Oklahoma Senate on July 14, 1965, and the House of Representatives passed the Resolution on July 15, 1965, to refer to the people of Oklahoma for their approval or rejection a constitutional amendment to provide for vocational and technical education in the State of Oklahoma.

This Resolution, which was passed by the citizenry of Oklahoma, provides for a levy not to exceed five mills on the dollar valuation of taxable property in any area school district to establish an area vocational school. Also, upon the establishment of an area vocational school district, such districts are authorized to become indebted separate and apart from the indebtedness of any school district included in the area district up to 5 per cent of the net valuation of taxable property within such area school district for capital improvements including purchasing sites, constructing, purchasing, improving and equipping real property and buildings when such indebtedness is approved by the majority of the electors of the area school district.

Upon passage of this Resolution by the people of Oklahoma, the State Board for Vocational Education established the following minimum criteria for approval of area vocational school districts:

1. The proposed area school district shall have a total minimum scholastic population of 15,000 or serve a fifty-mile radius from the proposed site of the school.
2. The proposed area school district shall have a minimum net assessed valuation of $40,000,000 after homestead exemptions.
3. An application shall be prepared which provides a complete picture of the proposed district in regard to size, population, assessed valuation, current school enrollments, including secondary school and elementary

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[47] Personal Correspondence of the Investigator, letter from Leroy H. Swenson, Director of Vocational Education, October 14, 1966.

enrollments, adult enrollments, employment opportunities and other information relating to a justification of a school.

The plan, approved by the State Board for Vocational Education, for formation of area school districts, provides that the State Board for Vocational Education shall make a study of a particular area of the State on request of school districts as indicated by resolutions signed by the boards of education representing school districts in the proposed area. An election on area participation shall be conducted in each separate district in a manner prescribed by the State Board and if the election results are favorable they shall be held as valid by the State Board for a period of twelve months.

Should a district present unfavorable results, they could again, by resolutions, request another election in no less than three months. The State Board may then form and designate the area school districts for vocational and/or technical education from the school districts who voted in favor of becoming a part of the vocational school district.

If the boundaries of an area school district are the same as those of an existing school district, the board of education of the existing school district shall serve as the school board of the entire area school district. If the boundaries of an area school district are not the same as those of an existing school district, the State Board for Vocational Education, through its designated representatives, shall conduct an election to provide for the governing board of the designated area school district. Five board members shall be elected for each district. However, the State Board for Vocational Education shall divide the district into four zones of approximately equal population and the election shall be conducted by the said board through its designated representatives. Four board members shall be elected, one from each of the four zones, and one member shall be elected at large and may be a resident of any one of the four zones. Board members shall be elected for five-year staggered terms. Territory may be annexed to or detached from an area school district at any subsequent time by the State Board for Vocational Education after the approval at an election called and held for such purpose by the State Board for Vocational Education.

Tuition may be charged for nonresident students enrolling in vocational and/or technical school education courses, but shall be subject to approval by the State Board for Vocational Education. An area school may operate a transportation system which shall also be approved by the State Board for Vocational Education.

Area school districts shall operate under and according to the existing school laws of Oklahoma unless otherwise provided by the State Board for Vocational Education. According to Oklahoma policy, the area vocational-technical school should provide training programs for high school students, post-high school students and adults. High school students may attend the vocational school a half-day and their own school a half-day. They receive credit for attendance at the vocational school and this credit applies toward a high school diploma issued by the home school. The area school could provide post-high school training on either a full-time or evening class basis. Part-time programs should be available for adults who are already employed. Short, comprehensive training programs should be organized to meet any training need that might be developed in the area served by the school. The area vocational-technical school in Oklahoma is one which shall serve a thirty to fifty mile radius depending upon the population of the area.

Under the terms of an amendment as it is presently written, area vocational schools cannot serve as community junior colleges. However, it is the prerogative of the Legislature to change this law in the event this should become feasible. Since the passage of this resolution, five area vocational schools have been established in Oklahoma.[48]

Oregon. In Oregon, area vocational-technical education is accomplished through a network of community colleges. Since community college programs involving college level academic course are within the same organization offering vocational-technical courses, the establishment of these institutions differs somewhat from the establishment of area vocational schools. The Oregon law under which community colleges are established defines an area education district as an area that includes more than one school district.

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[48] State Board for Vocational Education, Area Vocational-Technical Schools: A New Program Concept for Oklahoma (Stillwater: State Department of Vocational Education, undated).

The procedure for establishing a community college includes the filing of a locally initiated and signed petition proposing such a district with the State Board. The State Board conducts a hearing on the petition and, if approved, submits the petition to the registered voters residing within the boundaries of the proposed district.[49]

Under Oregon State Law the following criteria for the establishment of an education center or a community college are prescribed. These criteria apply equally to an area district or to a school district wishing to establish an education center or community college:

1. The residents of the geographical area concerned are not, in the opinion of the State Board, adequately served by an existing education center or community college or private school.
2. The enrollment in grades nine through twelve is at least 1, 500 pupils in an area education district or the geographic area to be served by a school district.

1, 500 pupils in an area education district or the geograph-ic area to be served by a school district.

3. Available building space is adequate for the courses to be opened.[50]

Additionally, the Board of Education of any school district not located within an area education district and not already conducting a program under the community college law may contract with the State Board of Higher Education, acting through the General Extension Division, for the holding of lower division collegiate classes or may contract with the State Department of Education for the holding of post-high school vocational courses. The Law also requires the Department of Education and the Division of Continuing Education to establish procedures to assure that duplication of classes does not occur.[51]

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[49] State Board of Education, Oregon Community Colleges: Annual Report (Salem, Oregon: State Department of Education, 1965), p. 6.

[50] Ibid.

Apportionments for operating expenses and building construction are prescribed by state law. A district board applying for funds for capital construction must submit to the State Board a long-range plan for the development of the center or college, evidence that the district will provide a suitable site, evidence of the ability of the district to finance costs in excess of the amount of state funds for which the district is eligible, a general description of the proposed project, and such other information as the State Board shall require. The State Board of Education shall submit the project application to the Emergency Board if the State Board is satisfied that the district has provided adequate evidence of the criteria defined. The State Board shall, upon approval of the application, determine priorities in the allocation of funds.[52]

Utah. In Utah, post-high school educational opportunity and vocational education is approached somewhat differently than many other states. In Utah the school districts are eligible to receive state and federal fund reimbursements when they conduct programs which meet the standards of their State plan. All vocational programs conducted in Utah's public schools have the approval of the State Board for Vocational Education.

Trade-technical institutes, junior colleges, colleges, and universities which receive state appropriations from the State Legislature are also eligible to receive state and federal vocational education reimbursements administered by the State Board for Vocational Education providing they meet the policies and standards enumerated in the State plan and obtain the approval of the State Board.

Public trade-technical institutes and other post-high school area vocational schools approved by the State Board for Vocational Education have the primary responsibility for conducting extension and part-time industrial vocational education within enrollee commuting distance of each school. School districts within this area are also encouraged to conduct this type of post-high school vocational education. School districts beyond commuting distance have the primary responsibility for conducting such vocational programs. The State Administrator for Vocational-Technical Education has the responsibility for coordinating extension and part-time programs in industrial vocational education with the assistance of the state vocational specialists and area school representatives in these fields, together with the district directors of vocational education.

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[51] Ibid., p. 7.

[52] Ibid.

Post-high school extension and part-time courses in agricultural education, industrial arts, homemaking education, office education, distributive education, and semiskilled job training are primarily the responsibility of school districts. Area vocational schools are also encouraged to conduct such programs. Where school districts within commuting distance of a trade-technical institute or junior college do not desire to conduct these programs, they notify the state specialists in these respective fields to this effect. After counseling with the State Administrator of Vocational-Technical Education, contact will be made with the trade-technical institute or junior college concerned where it will be encouraged to conduct such programs.

The State Administrator of Vocational-Technical Education shall have the responsibility for coordinating all vocational programs conducted in area vocational schools with state specialists of the various sections of the vocational division and the administrators of the schools concerned.

Vocational reimbursements from the State Department of Public Instruction to trade-technical institutes, junior colleges and universities are made for vocational and technical training conducted only at these educational institutions or in private establishments within enrollee commuting distance of these schools in which the training is conducted by area vocational schools. Vocational reimbursements to school districts from the State Department of Public Instruction are for vocational training programs conducted in the districts under the administration and general supervision of district superintendents of schools.

High schools in Utah are encouraged by the State Department of Education to offer vocational courses as a part of the education program. Programs in each vocational field in Utah consist of five to seven year-long courses arranged in sequence during the tenth, eleventh and twelfth years.

Summer programs for high school students in vocational education (vocational aides, vocational business and distributive education, vocational home economics, trades and industries and vocational agriculture) are regarded as an extension of school-year programs. They are designed to either supplement or to be an integral part of courses taught during the school year. In no case shall a student in the tenth, eleventh, and twelfth grades be registered for summer vocational courses who is not registered for such programs during the school year immediately preceding or succeeding the summer in which they are provided. Vocational courses which are conducted in the summer must be of sufficient length so that they may be equated on a semester or school-year basis when this credit is evaluated in high schools.

In Utah school districts, area vocational schools, trade-technical institutes, colleges, and universities are encouraged to provide inservice training for homemakers, semiskilled, skilled, and technician workers in keeping with approved standards for facilities and instructors and in terms of the needs of the workers.[53]

Wisconsin. A somewhat more rigid program of vocational education has developed in Wisconsin than in most other states. In order to qualify to become a district in Wisconsin by July 1, 1970, a district must satisfy minimum state standards in terms of students available for full-time and part-time instruction. Also, the potential district must have a basic equalized value which, along with state and federal aids, will support a quality educational program which is in line with the policies enacted by the State Board for Vocational-Technical and Adult Education and the Coordinating Committee for Higher Education.

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[53] State Board for Vocational Education, Policies on Relationships in Vocational Education Between Post High School Educational Institutions and School Districts in Utah (Salt Lake City: State Department of Vocational Education, 1965).

Several decisions made by these two bodies strongly affect area vocational school development in Wisconsin. The most important of these decisions are summarized as follows:

First, there must be at least one major educational unit in each district created which would offer all programs (including transfer education where permissible by law) and there must be centers or satellite schools to offer locally oriented day and evening programs. Also, evening programs must be extended to all communities in the district where there is a sufficient number of students to warrant the initiation of classes. It is the attempt in creating area organization to make maximum utilization of the staff of the central unit in providing service to the satellite schools.

The second decision made by the State Board for Vocational-Technical and Adult Education and the Coordinating Committee for Higher Education is that associate degree programs must be expanded and that the quality must be sustained at a high level. The courses must be transferable where practical and an option of course-choice within the curriculum must exist.

A third decision states that, "full-time certificate programs must be expanded, and insofar as possible the courses within a vocational curriculum should be transferable to the associate degree level if a student makes satisfactory progress."

Based upon these actions of the State Board for Vocational-Technical and Adult Education and the Coordinating Committee for Higher Education, the following assumptions were adopted for formulating criteria for the location of area vocational schools:

1. Most of the wider choice will come in the area of general education.
2. There are at least five major areas of general education including English, Social Science, Psychology, Mathematics, and Science.
3. The vocational-technical school is dealing with full-time post-high school students both in the vocational and technical program.
4. An average of twenty students must be enrolled in a class.
5. These should be offered at least two different times during

the course of the week which would produce a minimum enrollment of 920 full-time student equivalents.

6. A district must generate 3,800 high school graduates in the 1970's and through the 1980's in order to produce sufficient full-time equivalent students in vocational-technical education programs. This assumption is based upon the results of a survey which indicates that the rate of technical-vocational school attendance by high school graduates at present is approximately twelve per cent.[54] This report indicates that the rate has been increasing at approximately 1.5 per cent a year so that in 1970, eighteen per cent can be expected to be enrolled in full-time programs. On this basis, then, eighteen per cent of 3,800 graduates would produce 684 full-time students. However, it is assumed that each district can generate at least 235 students who would be continuing work from the previous year.[55]

7. The total population of 237,500 would be required to generate 3,800 high school graduates (graduating classes represent approximately 1.6 per cent of the total population).

8. An eighth assumption concerns part-time students. Wisconsin officials state that they cannot predict with any accuracy the number of part-time students which varies from 3.9 per cent to 10.0 per cent of the total population in a given community. On this basis, a district of 237,500 would produce between 9,262 and 11,875 students. Another method of predicting part-time enrollment in Wisconsin is comparing present full-time enrollment with part-time enrollment. In 1966, about eleven times more part-time than full-time students were enrolled. Using this estimate approximately 10,120 part-time students would be enrolled in 1970.

It is estimated that the cost per full-time student enrolled at a vocational-technical institute in Wisconsin will vary from $1,100 to $1,250 in 1970. On this basis, the cost of 920 full-time student enrollments would range between $1,012,000 and $1,150,000. For part-time student enrollment it is estimated that a cost ranging between $606,000 and $525,000 would be incurred. The total instructional cost, then, is estimated to range between $1,518,000 and $1,725,000 for a typical area vocational-technical school district.

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[54] Wisconsin Survey Research Laboratory, Educational Reactions of the 1964 Graduates of Wisconsin High Schools (Madison: Survey Research Laboratory, 1965).

[55] Ibid.

Wisconsin officials indicate that federal and state aids would supply approximately fifty-four per cent of the total operating costs, leaving approximately twenty-nine per cent to be funded from local tax revenue and approximately seventeen per cent to be funded from fees and tuition and other receipts. The facilities to accommodate 920 full-time students would require an outlay ranging from $1,840,000 to $2,760,000. This estimate is based on a construction cost of $2,000 to $3,000 per student suggested by the President's panel of consultants for vocational education. Since these criteria are being to be operational in 1970, interim criteria are being used at the present time.

Provisional districts may be approved utilizing the following interim criteria:

1. Each district must contain a central facility enrolling at least 500 full-time day students at the time of approval of application. The district's central facility must demonstrate the potential of reaching 920 full-time day students by 1970.
2. Each district must demonstrate that it can attain an equalized valuation of between $269,685,000 and $324,487,000 by July 1, 1970.
3. The proposed district plan must not conflict with the statewide master plan.

Summary

There seem to be many similarities and many dissimilarities between programs of vocational education in the states examined. For the most part, the states examined considered, in varying degrees, the factors utilized in developing the model in this study. However, none of the states examined attempted to determine the relative value of these factors.

Factors considered by the states surveyed in the location of area vocational schools which are-relative to the study are summarized in

Table I. These indicate that in the location of area vocational schools the factors most often considered are grade nine through twelve enrollment in the area, population characteristics, skills needed in the area, and the administrative structure of the area. Following closely in importance are factors concerning support and cost.

Factors least often considered in the location of area vocational schools are those concerned with distance to another vocational school, anticipated first-year enrollment, and geographic radius of the area vocational school district.

TABLE I

SOME FACTORS CONSIDERED BY THE STATES SURVEYED IN THE LOCATION OF AREA VOCATIONAL SCHOOLS

	STATES					
Factors	Arizona	Colorado	Georgia	Idaho	Kansas	Montana
Federal Support				x	x	
State Support				x	x	
Local Support			x	x	x	
Tuition			x		x	
First Year Enrollment					x	
Grade 9-12 Enrollment		x	x	x	x	
Population Characteristics		x	x	x	x	
Distance to Another Vocational School			x			
Radius of the Area		x	x	x		
Skills Needed in the Area	x	x	x		x	
Programs Offered First Year			x		x	
Assessed Property Valuation of the Area		x			x	
Administrative Structure	x		x	x	x	
Cost of Program	x		x	x	x	
Vocational Schools are Still in Planning Stage						x

TABLE I (continued)

	STATES				
Factors	North Dakota	Oklahoma	Oregon	Utah	Wisconsin
Federal Support		x	x	x	x
State Support			x	x	x
Local Support		x	x	x	x
Tuition		x	x	x	x
First-Year Enrollment				x	x
Grade 9-12 Enrollment		x	x	x	x
Population Characteristics		x	x	x	x
Distance to Another Vocational School			x		
Radius of the Area		x			
Skills Needed in the Area		x	x	x	x
Programs Offered First Year			x	x	x
Assessed Property Valuation of the Area		x			x
Administrative Structure		x	x	x	x
Cost of Program		x			x
Vocational Schools are still in Planning Stage	x				

CHAPTER II

REVIEW OF RELATED LITERATURE

A major problem facing the scientist is that of formulating adequate explanations of theories relating to the complex phenomena they observe.[1] In this chapter some of the most pertinent literature pertaining to the use of models to explain theory will be reviewed.

In an effort to solve the communication problem, scientists often attempt to construct models to explicate the phenomena under scrutiny. Such models often help the researcher to understand more completely the underlying relationships between the various components of the phenomena. Further, they usually enable the researcher to control certain factors while studying other factors in order to discover the way in which the various parts function.[2]

For many, the model represents a simplified version of the explanation of the phenomena that can be readily understood and studied. Models may be merely diagrams, mathematical formulae, or three dimensional representations. Webster, for instance, defines a model as (1) a set of plans for a building; (2) a copy; (3) a miniature representation of facsimile of a thing; or (4) style or design of structure.[3]

Another definition of the term "model" given by Kaplan which established its relevancy for use in contemporary methodology was, "something eminently worthy of imitation, an exemplar or ideal."[4]

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[1] Brother Leonard Courtney (ed.), Highlights of the 1965 Pre-Convention Institutes: Use of Theoretical Models in Research (Newark, Delaware: International Reading Association, 1965), p. 3.

[2] Ibid.

[3] Webster's New Collegiate Dictionary, (Springfield, Massachusetts: G and C Merriam Company, 1965), p. 544.

[4] Abraham Kaplan, The Conduct of Inquiry (San Francisco: Chandler Publishing Company, 1964), p. 258.

Maccia emphasized that educational theorizing is no longer rejected as mere speculation. Instead, it has been singled out as a critical need and a trend in research activity.[5] Carrol cited the need for a comprehensive theory and attendant models in the theory of language behavior.[6]

Another tenet stated by Maccia was that if an inquiry is scientific, it includes development of a hypothesis or hypotheses about reality and a model must reflect sequential development.[7] She also stated that a hypothesis or hypotheses must be in the context of other hypothesis. A single unrelated hypothesis or the combination of unrelated hypotheses offeres no cognitive problem solution.[8]

Holmes purported that theory building and the use of models to explain the theory is a creative process.[9] He stated that analogy is the heart of creativity, and, therefore, should be the central activity of the theory-models approach. He cautioned the scientist, however, that in creative thinking, the use of analogy should always be a guarded process because a "slick" analogy or model tends to relieve the researcher of responsibility for explaining phenomena in his own terms.[10]

Models, in general, may be described in terms of their use. Kaplan described models in relation to six styles.[11] The style which is most likely to be concerned with individuals, events, case studies, or clinical findings is described as a literary style. Sequences of behavior with certain significances are disclosed. The meaning of acts rather than action itself is considered most important.

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[5] Elizabeth S. Maccia, The Model in Theorizing and Research (Occational Paper 65-180, Bureau of Educational Research and Service, Columbus: The Ohio State University, 1965), p. 1.

[6] John B. Carrol, "Linguistics and the Psychology of Language," Review of Educational Research: Language Arts and Fine Arts, Volume 34, Number 2, (April, 1964), pp. 123-124.

[7] Maccia, op. cit., p. 2.

[8] Ibid.

[9] Jack A. Holmes, "The Theory-Model Approach," Highlights of the 1965 Pre-Convention Institutes: Use of Theoretical Models in Research, op. cit., p. 19.

[10] Ibid.

The academic style is more abstract and general than the literary style. Some attempt is made to be precise, but the attempt is verbal rather than operational. The academic style model utilizes words in special senses, to constitute a technical vocabulary. The materials utilized tend to be ideational rather than observational data. Consequently, the treatment of this material tends to be highly theoretical.

Intense interest in proof characterizes the eristic style. The most important data in this style are experimental and statistical in nature, and attention is given to deducing logical relationships.

Mathematics is the focus in the symbolic style model. The precision of mathematical ideas is important rather than the rigor of mathematical demonstration. The subject matter is conceptualized throughout the model in mathematical terms. Symbols are subjected to mathematical transformations, and measurement provides the content for the mathematical forms which are employed. Statistical data serve as evidence to substantiate the model. These data are also utilized to generate new hypotheses and new patterns of conceptualization.

The postulational style is a special variant of the symbolic style, although the two styles differ as logic differs from mathematics. The focus of attention rather than the content of the propositions which occur at the various steps provides the validity of proof of the postulational style model. This style model directs emphasis on the system as a whole, bound together by logical derivations.

The last style model described by Kaplan is the formal style. The essential difference between the formal style and postulational style model is that in the formal style model there is no reference to any specific empirical content. The validity of the model is not dependent upon content but upon the pattern of relationships among the symbols.[12]

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[11] Kaplan, op. cit., pp. 259-262.

Davis emphasized that a theory must be thoroughly explained.[13] He stated that once a model has been constructed, specific hypotheses are formulated and subjected to experimental testing. Therefore, the process of constructing a new model, testing it, and revising it in terms of new data continues until experimental confirmations of expectations derived from the theory are consistently obtained.[14]

Models have been used in a more literal sense by many industrial managers. Hall implied that a model is a logical means of determining and recording information relative to the nature of specific jobs or positions.[15] According to Hall management models outline functions, establish parameters of responsibility and authority, and describe the relationships between principals of the model.[16]

Industrial authorities have utilized another application of models in the location of plants. Their efforts have been directed primarily toward the identification and evaluation of factors having the greatest effect upon successful plant location. LeVan expressed the views of the DuPont Company when he outlined the procedures used by that company in the location of new plants.[17] Isard further validified this use of models in an explanation of plant location criteria.[18]

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[12] *Ibid.*

[13] Frederick B. Davis, "Theory Construction in Scientific Method," *Highlights of the 1965 Pre-Convention Institutes: Use of Theoretical Models in Research*, *op. cit.*, pp. 27-28.

[14] *Ibid.*

[15] George L. Hall, *The Management Guide* (Published by the Standard Oil Company of California, 1956), p. 5.

[16] *Ibid.*, pp. 18-21.

[17] F. E. LeVan, "Hardboiled Economics Guide Dupont in the Selection of Sites for Plants," *Industrial Development*, December, 1959, pp. 6-8.

[18] Walter Isard, Eugene W. Schooler, and Thomas Vietorisz,

Halpin defended the use of models in educational research but expressed some qualms about their use.[19] He admitted that administrators feel uncomfortable in the presence of theoretical models, and then offered the following explanation:

> The administrator's doubt is justified: there is indeed something missing. The fault is that the scientist's theoretical models of administration are too rational, too tidy, too aseptic. . . . The superintendent distrusts such tidiness in administrative theory and senses intuitively that the theoretical-analytical approach has ignored much that is reality.[20]

In criticizing the theoretical-model approach, Halpin does not condemn the approach but warns that scientists and researchers must use models more judiciously.[21]

Parsons has used models extensively in economic theory, in sociological theory, and in psychological theory.[22] A well-known representative model developed and published by Parsons was a model representing a "Theory of Social Stratification."[23] In this model Parsons emphasized both content and relationship of variables.

Getzels and Guba implied that the scientist can be especially helpful in devising models which will provide greater precision for describing the practitioner's observations so that the fruits of the practitioner's

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Industrial Complex Analysis and Regional Development (New York: John Wiley and Sons, Incorporated, and the Massachusetts Institute of Technology: The Technological Press, 1959), pp. 4-10.

[19] Andrew W. Halpin, Theory and Research in Administration (New York: The Macmillan Company, 1966), p. 284.

[20] Ibid.

[21] Ibid., pp. 285-290.

[22] Talcott Parsons and Edward A. Shils (eds.), Toward a General Theory of Action (Cambridge, Massachusetts: Harvard University Press, 1951), pp. 280-284.

[23] Talcott Parsons, Essays in Sociological Theory, Revised, (Glencoe, Illinois: The Free Press, 1954), pp. 386-411.

experiences and observations can be more effectively communicated.[24]

Although the limitations inherent in the use of models to explain theory restrict their application, their use as a useful tool in scientific explication is well established.[25]

A symbolic model employing mathematical symbols was chosen for this study because it provides the researcher or decision-maker with an analogue that can be manipulated to determine how changes in certain characteristics of the model affect other characteristics as well as the whole model. From such an understanding of the relationships among the characteristics of the model, predictions can be made regarding the real situation described by the model.

In the next chapter, a mathematical symbolic model will be constructed in order to predict the relative success of area vocational schools from knowledge of the district in which they are located. In areas where vocational schools are nonexistent, the model will be used to predict the outcome of the establishment of such schools.

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[24] Jacob W. Getzels and Egon G. Guba, "Social Behavior and the Administrative Process," The School Review, Volume 65, (Winter, 1957), pp. 423-442.

[25] Kaplan, op.cit., p. 277.

CHAPTER III

THE MODEL AND ATTENDANT FACTORS FOR LOCATING AND ESTABLISHING AREA VOCATIONAL SCHOOLS

I. RATIONALE

The factors affecting the location of area vocational schools differ in many respects from the specific factors governing the location of industries, the area in which practically all location studies have been conducted. It is apparent, as indicated by the review of selected state's vocational education programs, that there are different opinions among authorities as to the relative importance of factors in the location of area vocational schools--just as authorities in the field of industrial plant location disagree as to the specific techniques which should be used in selecting the site for a new manufacturing plant. The industrial plant location authorities are in general agreement, however, on one fundamental point--that plant location is a managerial function of the utmost importance.[1] F. E. LeVan, a senior engineer for DuPont who has played a key role in many plant location projects expressed their conviction in these words:

> "We approach the problem of plant site selection with the firm belief that it is one of the most critical decisions that industrial management has to make in considering a new plant. Competition in industry and rising costs have made it more and more imperative that all items affecting investment and cost of operation, where they can, be held to a minimum. Personal preference or selection at random has no place in plant site selection. Operating defects usually can be corrected at comparatively low cost, but faults of location are forever carried as a manufacturing burden."[2]

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[1] James H. Thompson, Methods of Plant Site Selection Available to Small Manufacturing Firms, Bureau of Business Research Bulletin, Series 62, Number 3-3 (Morgantown: West Virginia University, 1961), p. 1.

[2] Op. cit., p. 6.

Industrial location authorities have struggled for a long time with the determination of factors which optimize plant location.[3] In spite of the concentrated efforts of authorities to establish applicable criteria for the location of plant sites, and even though most manufacturing executives share the views of these experts as to the importance of the locational process, serious errors still occur with disturbing frequency in this area of management.[4]

Although the factors affecting the location of industrial sites may differ from those affecting the location of area vocational schools, the methods used in developing decision criteria appear to be quite similar. If this assumption is made, the results of a body of carefully conducted research in determining the relative significance of locational factors becomes available to educators.

II. THE MAJOR ELEMENTS OF THE MODEL

Identification of Major Elements

A review of literature on vocational schools and an investigation of the criteria used by various states in establishing these schools indicated a number of factors which appear to be relevant to the successful location of area vocational schools.

Burns identified a number of these factors in a study of area vocational schools in Missouri.[5] The following primary factors were identified by Burns as important in locating and establishing area vocational schools:

1. Number of high school students.
2. Amount of taxable wealth.

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[3] LeVan, op. cit., p. 6.

[4] Thompson, loc. cit.

[5] Richard L. Burns, "Factors Governing the Establishment and Operation of Area Vocational-Technical Schools and Programs in the United States with Application to Missouri," (Unpublished Doctor's Thesis, The University of Missouri, Columbia, 1964), p. 5.

3. Geographic area in square miles.
4. Extent of student interest.
5. Extent of industrial support.
6. Number and types of training agencies.
7. Type of legal governing body.
8. Type of administration.

In the present study it was hypothesized that the following district characteristics were relevant to the successful location of area vocational schools:

1. Number of students by grade level enrolled in public and private schools in the area.
2. Dropout rate of schools in the area.
3. Total and projected population of the area.
4. Assessed valuation of the area.
5. Present tax load in the area.
6. Finance resource potential of the area. (In addition to that based upon assessed valuation of the area).
7. Industry and business in the area--planned and present.
8. Present and predicted statewide and nationwide employment opportunities for trainees from vocational and technical education programs.
9. The ability of the area to show need (present need plus expansion plus turnover) in at least five divisions of vocational-technical education.
10. Distance between possible area vocational schools.
11. Ability to attract and hold faculty.

These characteristics were submitted to thirty individuals who were considered to be authorities on vocational education. They were asked to rank the factors according to their relative importance. A one hundred per cent response was achieved, although one respondent declined to rank the factors.

Kendall's Test of Concordance was applied to the responses with the results, W = 0.254. This significance of W was tested utilizing the chi-square formula, $x^2 = \frac{s}{1/12\ kn(n+1)}$ as published by Siegel.[6] Degrees of freedom are obtained by the formula, df = n-1. When the null hypothesis, "The rankings are unrelated," was tested the resulting chi-square value of 73.66 causes this hypothesis to be refuted at the highly significant level of confidence: $x^2_{.01} = 23.21$ with 10 degrees of freedom. The meaning of significance at the 0.01 level is that such a correspondence in rankings among the judges could have occurred by chance less than one time in a hundred.

When the data were collapsed, that is, when the data applying to each major function were combined, in relation to the three major factor-areas comprising the theoretical structure of the model (area vocational school input potential, market for area vocational school graduates, and financial considerations) and tested with Kendall's Coefficient of Concordance Technique, a W = 0.333 was calculated. The null hypothesis again was, "The rankings are unrelated." When the chi-square formula, $x^2 = k(n-1)W$,[7] was applied, the resultant $x^2 = 96.57$ causes the rejection of the null hypothesis at a highly significant level of confidence since $x^2_{.01} = 9.21$ with 2 degrees of freedom.

In summary, a high or significant value of W when tested by the chi-square may be interpreted as meaning that the respondents applied essentially the same standard in the ranking of the factors under study.[8]

Table II contains the factors ranked in the order of their relative importance and Table III contains the ranks of the three groups of factors.

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[6] Siegel, op. cit., p. 236.

[7] Ibid.

[8] Ibid., p. 237

TABLE II

FACTORS AFFECTING THE LOCATION AND ESTABLISHMENT OF AREA VOCATIONAL SCHOOLS RANKED ACCORDING TO THEIR RELATIVE IMPORTANCE

Rank	Factor
1	Number of students by grade level enrolled in public and private schools in the area.
2	Total and projected population of the area.
3	Industry and business in the area - planned and present.
4	Present and predicted statewide and nationwide employment opportunities for trainees from vocational and technical education programs.
5	Can the area show need (present need plus expansion and turnover) in at least five divisions of vocational/technical education?
6	Dropout rate of schools in the area.
7	Assessed valuation of the area.
8	Finance resource potential of the area. (In addition to that based upon assessed valuation of the area).
9	Distance between possible area vocational schools.
10	Present tax load in the area.
11	Ability to attract and hold faculty.

TABLE III

RELATIVE IMPORTANCE OF MAJOR FACTOR-AREAS IN LOCATION AND ESTABLISHMENT OF AREA VOCATIONAL SCHOOLS

Rank	Factor area
1	Input Potential
2	Market for Graduates
3	Financial Considerations

III. THE MODEL

A preliminary decision model for the location of area vocational schools was constructed from the factors from the survey. The model is outlined in Figure 1.

There are three major characteristics of the model, namely, potential input or enrollment in the school's program, existing job opportunities for graduates, and adequate financial support.

Potential input, or enrollment, in the school is influenced by a number of demographic characteristics of the district in which it is located such as population, public school enrollments and available job opportunities.

Market for graduates, or job opportunities for graduates, is influenced by the overall labor situation at the national, state, and local levels. Also, placement of graduates appears to be affected by the quality of the instructional staff.

Finally, financial support is provided from federal, state, and local sources and from tuition.

In order to predict whether or not a district could successfully support a vocational school, it is first necessary to relate each of the variables included in the prediction model to the degree of success of existing area vocational programs.

The model to be developed provides a method for combining the relative contributions of each variable to the prediction of the overall success of a school. While it is unlikely that any one district will possess all of the ideal characteristics for a successful program, in many instances, those which it does possess will provide an adequate basis to predict the relative success of an area vocational school, if it were established in that district.

The development of such a model to assist in predicting whether or not a region could provide the necessary support for vocational programs and the analysis of the relative contributions of each variable to the successful location of area vocational schools is the purpose of this chapter.

Input Potential

The first step in evaluating the first major factor--input potential--is the determination of the necessary initial enrollment if a new area vocational school is to be successful.

Data in Table IV indicate that the schools surveyed tend to have a small beginning enrollment ranging from sixteen to 1,387 students with a mean enrollment of 192. In 1966 these same schools range in size from fifty-eight to 2,300 students with an average enrollment of 411.

The data also indicate that fifty per cent of the area vocational schools, in their first year of operation, enrolled between fifty-one and 150 students while only four schools, or five per cent, enrolled over 500. Fifty-three per cent of the area vocational schools have enrollments in 1966 of 101 to 400 students.

The potential area vocational school enrollment, or input, is determined by a number of factors. Some of these factors, such as the image of vocational education in the community and unexpected industrial location in the area or unexpected discontinuation of a large business or industry in the area, are generally not subject to quantification. Other factors, however, are identifiable and can be evaluated quantitatively. A graphic illustration of the factors considered in the study are shown in Figure 2.

The questionnaire responses indicate that the average vocational school surveyed has been in operation 3.7 years and its enrollment has grown by 69.43 students per year.

Shown in Table VI are the mean, median, largest, and smallest number of people accommodated in an area vocational school district. Those schools which are considered statewide schools and which accommodate students on a statewide basis have been excluded from Table VI. The data indicate that the smallest area population in which an area vocational school is located was 4,238, and the largest was 550,000. The mean population of 162,256 was somewhat high as a measure of central tendency because of the effect of a relatively few large areas.

The study revealed that 0.30 per cent of the present total population was enrolled in area vocational schools while, in the first year of operation, 0.14 per cent were enrolled. Although area vocational school enrollment

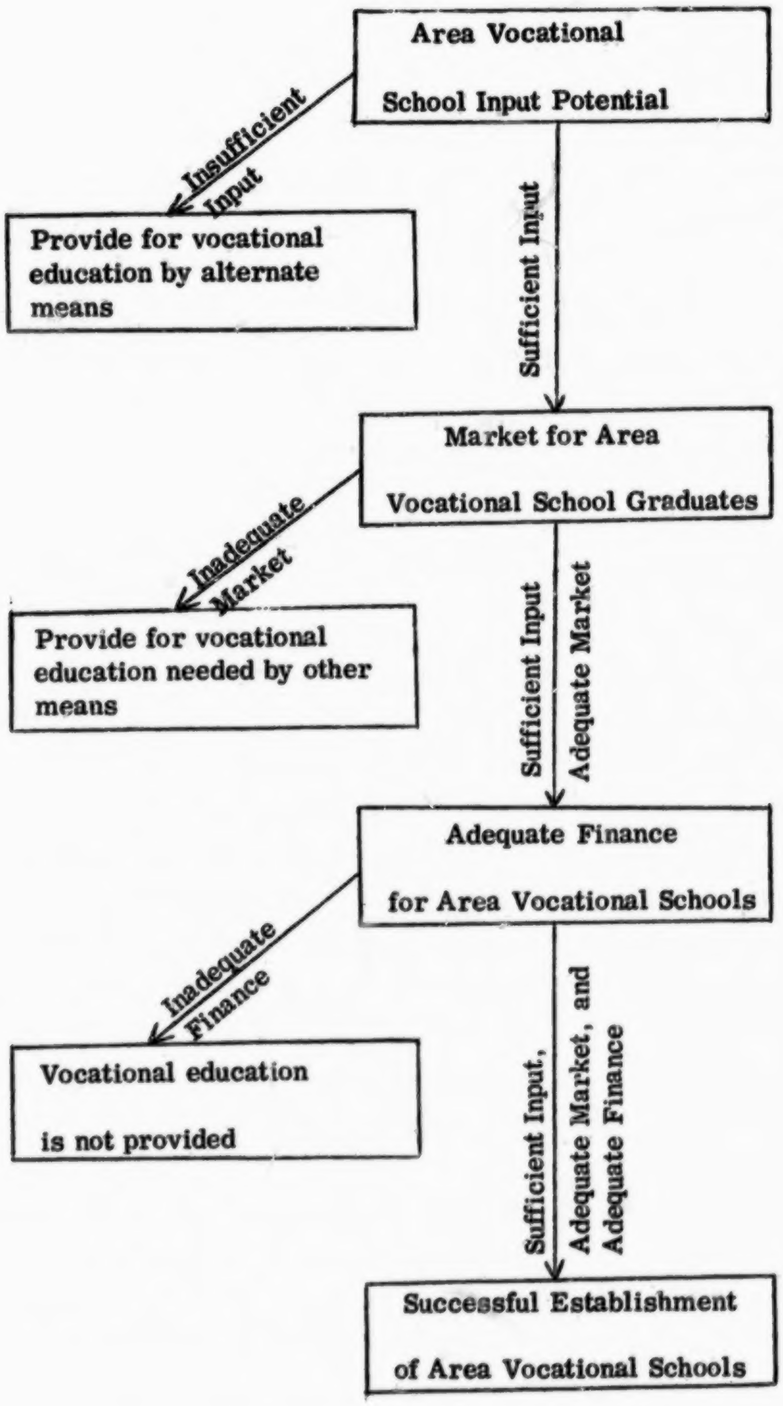
Area Vocational
School Input Potential
Insufficient Input
Provide for vocational education by alternate means
Sufficient Input
Market for Area
Vocational School Graduates
Inadequate Market
Provide for vocational education needed by other means
Sufficient Input
Adequate Market
Adequate Finance
for Area Vocational Schools
Inadequate Finance
Vocational education
is not provided
Sufficient Input,
Adequate Market, and
Adequate Finance
Successful Establishment
of Area Vocational Schools

FIGURE 1

A MODEL FOR LOCATING AND ESTABLISHING AREA VOCATIONAL SCHOOLS

TABLE IV

PRESENT AND FIRST YEAR ENROLLMENT IN AREA VOCATIONAL SCHOOLS IN STATES SURVEYED

Numbers of students	1966		In First Year of Operation	
	Number of schools	Distribution in per cent	Number of schools	Distribution in per cent
Less than 50	0	0	7	7.45
51-100	8	8.51	26	27.66
101-150	18	19.15	23	24.47
151-200	17	18.09	18	19.15
201-300	12	12.77	9	9.57
301-400	9	9.57	2	2.13
401-500	7	7.45	5	5.32
501-600	8	8.51	1	1.06
601-700	6	6.38	1	1.06
701-800	3	3.19	0	
Over 800	6	6.38	2	2.13
Totals	94	100.00	94	100.00

TABLE V

PRESENT AND FIRST YEAR ENROLLMENT INFORMATION IN AREA VOCATIONAL SCHOOLS IN STATES SURVEYED

	1966	In First Year of Operation
Enrollment distribution	Enrollment	Enrollment
Mean	411	192
Median	299	121
Largest	2300	1387
Smallest	58	16

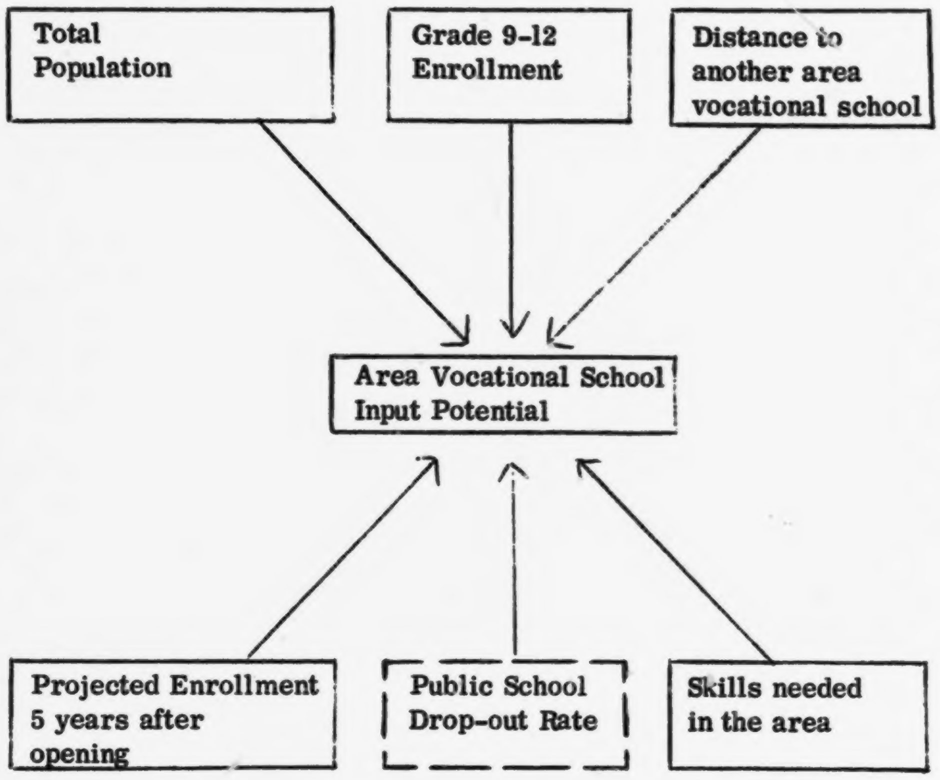
Total Population
Grade 9-12 Enrollment
Distance to another area vocational school
Area Vocational School Input Potential
Projected Enrollment 5 years after opening
Public School Drop-out Rate
Skills needed in the area

FIGURE 2

FACTORS INFLUENCING AREA VOCATIONAL SCHOOL INPUT appears to be a function of total population as evidenced by a correlation coefficient of 0.87, there were notable exceptions. For example, 0.04 per cent of one district with a large population were enrolled in area vocational schools while 4.5 per cent of a much smaller area were so enrolled. The coefficient of correlation of area vocational school enrollment in relation to total population the first year of operation was 0.82.

The data in Table VII show that two areas were supported by an enrollment in grades nine through twelve of less than 2,000 students. In the first year of operation, twenty-five area vocational schools were supported by an enrollment of less than 2,000 in grades nine through twelve. The mean nine through twelve enrollment was 6,427 in 1966 and 6,186 during the first year of operation. Thirty-six of the schools surveyed had projected the nine through twelve enrollment five years after the beginning of their area vocational school. The mean enrollment thus projected was 8,925 students.

The mean distance of the area vocational schools surveyed from the nearest similar institution was sixty-one miles in 1966 and seventy-five miles the first year of operation. A personal interview by the investigator with each of the state directors of vocational education and approximately twenty per cent of the chief administrative officers of the schools surveyed revealed that distance between area vocational schools had little adverse effect on enrollment. At least one-half of the persons interviewed related instances in which nearby schools had mutually benefitted from the programs of the other school.

The data in Table VIII are relevant both to the input potential of area vocational schools and to the second major factor of the model--market for the area vocational school graduates. These data show the greatest demand was for clerical and sales personnel, service personnel, and workers in machine trades.

The data in Table IX show the percentage of area vocational schools offering instruction in the same classification of skills. Shown also are the relationships between skill need in the area as reflected by the job opportunities available and vocational programs offered. Additionally, these data show that even though area vocational school offerings are related to job opportunities, a far greater need exists than is being trained. For

TABLE VI

PRESENT AND FIRST YEAR TOTAL POPULATION WITHIN THE AREA VOCATIONAL SCHOOL AREA

Population distribution	1966 Population	In First Year of Operation Population
Mean	162, 256	165, 403
Median	117, 368	129, 500
Largest	550, 000	504, 963
Smallest	4, 238	3, 485

TABLE VII

GRADES 9-12 ENROLLMENTS IN HIGH SCHOOLS WITHIN AREA VOCATIONAL SCHOOL DISTRICTS IN 1966 AND IN THE FIRST YEAR OF OPERATION

	1966		First Year of Operation	
School enrollment	Number of schools	Per cent of total	Number of schools	Per cent of total
Less than 2000	2	2.127	25	26.595
2001-2500	7	7.446	2	2.127
2501-3000	7	7.446	3	3.192
3001-3500	8	8.511	8	8.511
3501-4000	7	7.446	8	8.511
4001-4500	8	8.511	8	8.511
4501-5000	3	3.192	2	2.128
5001-5500	6	6.382	5	5.319
5501-6000	3	3.192	1	1.064
6001-6500	2	2.127	0	-
6501-7000	3	3.192	2	2.127
7001-7500	5	5.319	5	5.319
7501-8000	3	3.192	3	3.192
8001-8500	4	4.255	2	2.127
8501-9000	4	4.255	3	3.192
9001-9500	1	1.064	0	-
9501-10000	21	22.343	17	18.085
Totals	94	100.00	94	100.00

TABLE VIII

JOB OPPORTUNITIES WITHIN THE VOCATIONAL SCHOOL AREA IN 1966 AND IN THE FIRST YEAR OF OPERATION

Occupational area	Percentage of Vocational School Areas in Which Job Opportunities Exist 1966	 First year of operation.
Professional, Technical, Managerial	85	77
Clerical and Sales	98	97
Service	94	94
Farming, Fishing, Forestry	83	81
Processing	75	72
Machine Trades	91	88
Bench Work	50	50
Structural Work	64	64
Miscellaneous	13	13

example, ninety-eight per cent of the areas reported job opportunities in the clerical and sales skills and only eighty-seven per cent of the schools were offering these kinds of courses. A more dramatic discrepancy is in the service skills. Ninety-four per cent of the areas reported job opportunities in these skills but only forty-seven per cent of the area vocational schools were offering courses to satisfy this demand.

The effect of public school dropout rate on area vocational school enrollment is an extremely difficult factor to quantify. The median high school dropout rate for fifty states and the District of Columbia was 29.4 per cent in 1963.[9] The high school dropout rate in New Mexico during this same period was 37.8 per cent.[10] The high school dropout rate of the states surveyed paralleled the national median. Since the median high school dropout rate is assumed to have a common effect, the degree to which an area exceeds or falls below the median is considered to be a factor influencing enrollment in vocational programs.

Market for Graduates

Figure 3 provides a graphic illustration of the factors contributing to the second major characteristic of the model--market for area vocational school graduates.

The data in Table VIII indicated that clerical and sales jobs were available in ninety-eight per cent of the areas; service jobs were available in ninety-four per cent of the areas; and machine trades jobs were available in some ninety-one per cent of the areas. The occupational skills with least opportunities in the states surveyed were bench work and structural. Even these skills were needed in over one-half of the areas studied, however.

The schools surveyed indicated without exception that their problem was not one of placing their graduates, but rather one of satisfying the demand for skillsed tradesmen. These schools reported that sixty-three per

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[9] National Education Association, Research Division, Rankings of the States, 1963, Research Report 1963-R1. (Washington: The National Education Association, 1963), p. 47.

[10] Ibid.

TABLE IX

PROGRAMS OFFERED BY AREA VOCATIONAL SCHOOLS IN 1966 AND IN THE FIRST YEAR OF OPERATION

Occupational area	Percentage of Schools Offering Programs in Major Occupational Areas in 1966.	Percentage of Schools Offering Programs in Major Occupational Areas in the First Year of Operation
Professional, Technical, Managerial	45	27
Clerical and Sales	87	65
Service	47	32
Farming, Fishery, Forestry	49	30
Processing	18	10
Machine Trades	90	90
Bench Work	21	21
Structural Work	40	34
Miscellaneous	40	34

cent of their graduates were working in the immediate geographic proximity, and thirty-one per cent were employed outside the immediate geographic proximity. Only six per cent of the graduates were unemployed and this could be attributed in large part to females who had graduated from an area vocational school, married, and were raising a family.

Eighteen per cent of the first year classes and fifteen per cent of the 1966 classes in area vocational schools acquired sufficient skill to satisfy employers before completing of the prescribed courses and dropped out of the area vocational school to accept jobs.

The experience of area vocational school teachers appears to influence the placement of graduates of such schools, according to the personal responses of the persons interviewed. In the first place, all area vocational schools had adopted strict policies prescribing an acceptable level of practitioner experience for their teachers. Additionally, some schools, notably those associated with community colleges and junior colleges, required various levels of academic preparation.

Secondly, many employers consider the occupational background of the teachers in the schools when considering graduates from their courses for employment. As a result many area vocational schools dropped academic requirements completely from their preparation standards. All area vocational schools, however, were conducting in-service programs to upgrade the quality of instruction.

The levels of preparation of currently employed personnel are shown in Table X As shown by these data there were 1,733 teachers in the area vocational schools surveyed. Of this number only nine, or 0.52 per cent, had earned a doctor's degree. Approximately one-fourth had earned a master's degree, and one-fourth had earned a bachelor's degree. Just under one-half of the area vocational school teachers had earned no degree, although approximately one-fourth had earned at least some college credit, primarily through the in-service program.

A comparison of these data with total enrollments indicate that, in the first year of operation, the student-teacher ratio was 16.6 students per teacher. In 1966 the student-teacher ratio was 21.73 students per teacher.

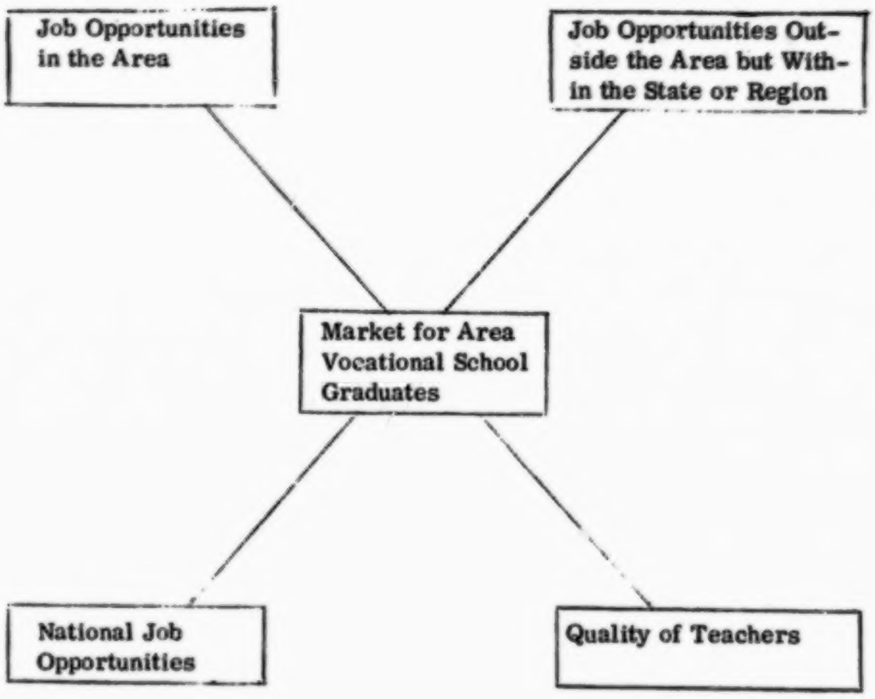
Job Opportunities in the Area
Job Opportunities Outside the Area but Within the State or Region
Market for Area Vocational School Graduates
National Job Opportunities
Quality of Teachers

FIGURE 3

FACTORS INFLUENCING MARKET FOR AREA VOCATIONAL SCHOOL GRADUATES

TABLE X

LEVEL OF PREPARATION FOR AREA VOCATIONAL SCHOOL TEACHERS

Level of preparation	Number of teachers	Percentage of teachers
Doctorate	9	0.52
Master's Degree	455	26.26
Bachelor's Degree	477	27.52
College Education but less than a Bachelor's Degree	451	26.03
Trade School	199	11.48
Union or Apprentice Training	95	5.48
Other	47	2.71
Totals	1733	100.00

Financial Support

The components of the third major characteristic, financial support, are shown in Figure 4.

There seem to be three dimensions to the financing of area vocational schools-operational costs, capital outlay costs, and student aid costs. Student aid costs, however, have not been considered in the location and establishment of area vocational schools because eighty-three per cent of the students currently attending area vocational schools are doing so without outside aid. Of the approximately 6,000 students who were receiving outside aid, nearly one-half were participating in work-study programs. Data in Table XI summarize the sources of aid for those students aided in 1966 and in the first year of operation.

The cost of operations, excluding capital outlay, is shown in Table XII. The mean cost per student for 1965-66, 1,080 clock hours of instruction, was $968. The median cost was $1,000 while the most any school spent was $1,267. One school, operating under the administration of a high school, reported a per pupil cost of $396.

The capital outlay required for area vocational schools averages $2,310.85 per student currently enrolled in the school. The capitalized values of area vocational schools investigated are shown in Table XIII. These data show that the capitalized value of the largest area vocational school was $4,000,000 while one high school attributed $38,205 of its capital outlay to its area vocational school. The mean cost per area vocational school for capital outlay purposes was $1,247,706.

Funds for financing the operational and capital outlay costs of area vocational schools typically were obtained from four sources--local, state, federal, and tuition--although no tuition or fees were used for capital outlay purposes.

The relative proportion of these funds varied widely. Generally, in states where area vocational schools operated on a statewide basis, funds were obtained from primarily two sources--state and federal. In most states where area vocational schools were operated by local boards the primary sources of funds were either local and federal or local, state, and

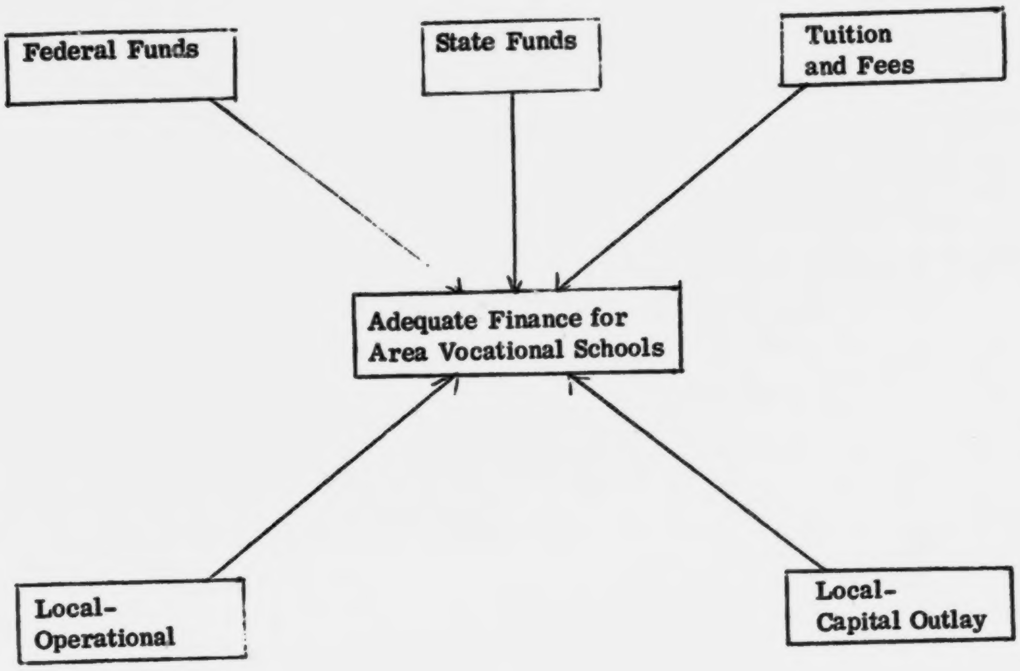
Federal Funds
State Funds
Tuition and Fees
Adequate Finance for Area Vocational Schools
Local-Operational
Local-Capital Outlay

FIGURE 4

FACTORS INFLUENCING ADEQUATE FINANCING OF AREA VOCATIONAL SCHOOLS

TABLE XI

SOURCES OF STUDENT AID FOR STUDENTS RECEIVING FINANCIAL AID

	Percentage of Students	
Source of aid	1966	First year of operation
Federal Scholarships	13	19
State Scholarships	19	35
Local Aid	10	10
Loans	5	4
Work-Study	42	25
Other	11	7

TABLE XII

AREA VOCATIONAL SCHOOL COST PER STUDENT FOR OPERATIONS FOR TWELVE MONTHS IN SCHOOLS SURVEYED

Distribution of cost	Cost
Mean	$ 968.00
Median	$1000.00
Largest	$1267.00
Smallest	$ 396.00

TABLE XIII

CAPITALIZED VALUE OF AREA VOCATIONAL SCHOOLS IN STATES SURVEYED

Distribution of values	Capitalized value
Mean	$1,247,706.00
Median	$1,068,549.00
Largest	$4,000,000.00
Smallest	$ 38,205.00

federal. Some tuition was charged by 60.5 per cent of the schools surveyed during their first year of operation. Since beginning operation, one school added a tuition charge. Data in Table XIV show the percentages of revenue from each source in the first year of operation and in 1966.

From the data it may be seen that the pattern of financing area vocational schools has remained relatively unchanged. The only noticeable change is that the amount of tuition charges are slightly lower. Of the schools charging tuition, the average annual tuition charged was $90.00 in 1965-66.

Assessed valuations were of little concern to the area vocational schools which were supported primarily from federal funds and state appropriations, and very few of these valuations were known by vocational school administrators. Where the area vocational schools depended upon a local levy for a sizeable amount of their revenue, the assessed valuation of the area became a critical issue. The mean, median, largest, and smallest assessed property valuations in the states surveyed are shown in Table XV.

The median assessed valuation of an area vocational school district was $188,255,907. Thus, if an area vocational school with median enrollment, 299 students, incurred a median operational cost per student, and received the median amount of revenue from federal sources, slightly over a one mill levy would be required for operational costs. If mean values were used, slightly less than a one mill levy would be required for operational costs.

IV. PREDICTION OF THE RELATIVE SUCCESS OF AREA VOCATIONAL SCHOOLS BY MEANS OF DISCRIMINANT ANALYSIS

Rationale of the Discriminant Function

Data in Tables IV through XV summarize a description of the characteristics of area vocational schools, but these data do not infer which of the characteristics distinguish successful from less successful schools. These kinds of descriptions, however, had to suffice as the basis of location of area vocational schools in the past.

TABLE XIV

PERCENTAGES OF REVENUE FOR AREA VOCATIONAL SCHOOLS BY SOURCE

	Per cent of Revenue	
Source	1966	First year of operation
Tuition	10.73	11.52
Local Levy	13.91	15.16
State Appropriations	38.89	37.02
Federal Allocations	36.41	36.21
Other	0.06	0.09
Total	100.00	100.00

TABLE XV

PRESENT ASSESSED VALUATION OF AREA VOCATIONAL SCHOOL DISTRICTS

Distribution of valuations	Assessed valuation
Mean	$232,866,007.00
Median	$188,255,907.00
Largest	$847,420,000.00
Smallest	$ 2,428,248.00

Initially, it was concluded that if a single variable, uninfluenced by other variables, could be used with a high level of confidence to predict successful area vocational school location, it would be folly to attempt to add complexity to the process by considering other variables.

The area vocational schools were divided into two groups--successful and less successful--based upon the present apparent success of the school as evidenced by present enrollment, rate of growth, and number of courses offered, and upon the opinions of the respective state directors of vocational education. The schools classified as less successful were placed in Group I and those classified as successful were placed in Group II. Once this classification was completed, the discriminant analysis procedure provided a means of determining if there are significant differences between the characteristics of the two groups.

In order to determine the accuracy of classification based upon a single variable, each variable was used singly to predict the classification of each area vocational school. The results of this classification technique are shown in Table XVI. The data indicate conclusively that the use of a single variable to predict the success of the schools included in the study results in appreciable misclassification when the procedure is compared with the original classification of each school. For example, the exclusive use of the variable, Number of Vocational Programs Offered, which, on the surface, seems to have the greatest influence upon the successful location of area vocational schools, resulted in misclassification 30.85 per cent of the time. The data in Table XVI also show that the exclusive use of the factor, Financial Support from Federal Allocations, resulted in incorrect decisions 73.40 per cent of the time.

The probability of error indicated in the last column of Table XVI, however, does not imply that these factors do not affect successful location of area vocational schools, but that decisions relating to area vocational school classification into successful or less successful categories can be improved by considering a number of variables simultaneously.

In searching for a procedure that would permit the development of a criterion for predicting the relative success of area vocational schools from a knowledge of a number of demographic characteristics, consideration

TABLE XVI

CLASSIFICATION OF LESS SUCCESSFUL AND MORE SUCCESSFUL AREA VOCATIONAL SCHOOLS BY USING SINGLE VARIABLES

Variable	Group				Percentage which would be misclassified if this variable were used
	Less Successful		More Successful		
	Properly classified	Improperly classified	Properly classified	Improperly classified	
Anticipated first year enrollment in an area vocational school.	20	2	34	38	42.55
Enrollment in grades 9-12 in high schools within the proposed area vocational school district.	18	4	46	26	31.91
Five year projected enrollment in grades 9-12 in high schools within the proposed area vocational school district.	16	6	51	21	28.72
Total population within the proposed area vocational school district.	21	1	45	27	52.13
Estimated size of staff during the first year in an area vocational school.	18	4	34	38	44.68
Distance to another vocational school.	15	7	21	51	61.70
Categories of skills needed within the proposed area vocational school district.	11	11	48	24	37.23

TABLE XVI (Continued)

Variable	Group				Percentage which would be misclassified if this variable were used
	Less Successful		More Successful		
	Properly classified	Improperly classified	Properly classified	Improperly classified	
Categories of anticipated programs offered first year in an area vocational school.	14	8	51	21	30.85
Primary Control--state or local.	7	15	54	18	35.11
Percentage of support from federal allocation.	8	14	21	51	73.40
Percentage of support from state allocation.	12	10	26	46	59.57
Percentage of support from local levies.	7	15	50	22	39.36
Percentage of support from tuition.	12	10	41	31	43.62

was given to a number of techniques. The procedure which seemed most applicable was that of discrimant analysis.

History of the Discriminant Analysis Procedure

Distriminant analysis was first applied in 1935 by Barnard at the suggestion of Fisher.[11] Fisher, himself, used the discriminant analysis procedure to classify two forms of the black locust tree.[12]

Since this time, the discriminant function has been applied to such problems as the quality rating of sheep, potato grading, cotton strain selection, classification of hair color, selection of plant lines, and the selection of successful specialty salesmen.[13]

In 1938 Fisher demonstrated the similarity of the two-group discriminant function to multiple regression, Mahalanobis' concept of generalized distance, and Hotelling's generalization of "Student's" ratio.[14]

Subsequently, Travers, Garrett, and Wherry have also demonstrated the value of the discriminant analysis procedure in the classification of individuals into one of two groups.[15] One of the most recent comprehensive descriptions of the multiple discriminant analysis function is contained in a paper published by Rao in 1948.[16] In this paper Rao shows how two discriminant functions were computed in order to achieve maximum classification of individuals into one of three Indian castes.[17]

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[11] M. M. Barnard, "The Secular Variations of Skull Characters in Four Series of Egyptian Skulls," Annals of Eugenics, Volume 6 (1935), pp. 352-371.

[12] G. W. Brown, "Discriminant Functions," Annals of Mathematical Statistics, Volume 18 (1947), pp. 514-528.

[13] David W. Tiedeman, "The Utility of the Discriminant Function in Psychological and Guidance Investigations," The Harvard Educational Review, Volume 21 (1951), p. 77.

[14] Ibid.

[15] Ibid. (as cited in Tiedeman).

[16] C R. Rao, "The Utilization of Multiple Measurements in Problems of Biological Classification," Journal of the Royal Statistical Society, Series B, X, Volume 2 (1949), pp. 17-29.

The discriminant analysis function has been subsequently applied in a number of studies, primarily in the areas of biometry and psychometry.[18]

Description of the Discriminant Analysis Procedure

Discriminant analysis is a procedure by which individuals may be classified into two or more groups. In this study area vocational schools were classified into two groups--less successful and successful. The discriminant analysis was performed with a computer which provided (1) a measure which may be used to determine whether a significant difference exists between the groups; (2) discriminant function scores for each group; and (3) the correct classification of each individual school comprising the sample.

Wheeler more succinctly describes discriminant analysis as a technique which evaluates applicable factors and leads to a single variable for differentiating groups. The variable which is thus achieved is a weighted combination according to prescribed criterion. The definition of the discriminant function, as stated by Burke is quoted by Wheeler.[19]

> Suppose we have a set of m indicators on the basis of which we wish to differentiate two groups of size n_1 and n_2. Let x_{ijk} represent the value obtained for k^{th} indicator on the i^{th} case in the j^{th} group. Then the basic data are represented by $m(n_1+n_2)$ values of the indicators x_{ijk}, $i = 1, 2, \ldots\ldots, n_j$; $j = 1, 2$; $k = 1, 2, \ldots\ldots, m$. Any weighted linear combination of the indicators gives the value z_{ij} for the i^{th} case in the j^{th} group where,
>
> $$z_{ij} = \sum_{k=1}^{m} \lambda_k x_{ijk}, \quad \begin{array}{l} i = 1, 2, \ldots\ldots, n_j. \\ j = 1, 2 \end{array}$$
>
> The m weights λ_k are arbitrary. For any choice of a set of weights, a value of z_{ij} can be computed for each case from the known values of x_{ijk} for the case. For some choices of

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[17] Ibid.

[18] Rao, op. cit., p. 78.

[19] Lawrence Wheeler, Perceptual and Motor Skills: Complex Behavioral Indices Weighted by Linear Discriminant Functions for the Prediction of Cerebral Damage. Indiana University, Southern Universities Press

the weights, the resulting values of z_{ij} might differentiate the two groups poorly; for the other choices, well. The problem is to find a unique set of weights which is optimal in some way.

Let us assign an arbitrary set of weights λ_k. For this fixed set, we compute a unique value of z_{ij} according to this formula previously stated, for each individual in each group. Obviously we can compute the mean and variance of the z_{ij} values for each group according to this formula:

$$\bar{z}_j = (1/n_j) \sum_{i=1}^{n_j} z_{ij}, \ j = 1, 2; \text{ and}$$

$$s_j^2 = (1/n_j) \sum_{i=1}^{n_j} z_{ij}^2 - (z_j)^2, \ j = 1, 2.$$

A "good" set of z_{ij} values should give relative homogeneity among S's within either group and heterogeneity between the two groups. In quantitative terms, we seek values of the weights, λ_k, which give a large absolute difference between the group means $\bar{z}_1 - \bar{z}_2$ and a small value for the within groups sum of squares. In practice we achieve the desired result by finding the set of weights λ_k which maximizes the criterion ratio:

$$Cr = (\bar{z}_1 - \bar{z}_2)^2 \ / \ (n_1 s_1^2 + n_2 s_2^2).$$

The solution of the problem of maximizing the criterion ratio is given below. Under conditions which are nearly always met in sets of actual data, a unique solution, i.e., a unique set of weights which maximizes the criterion ratio can always be found with relative ease by the following procedure:

Let $\vec{x}$ be a 1 X m row vector whose k^{th} component is the group difference on the k^{th} indicator and $\vec{\lambda}$ the vector of the weights. Further let S be the m x m matrix of the pooled within-groups covariances; $S = s_{\alpha\beta}$, where

$$S_{\alpha\beta} = \sum_{j-1}^{2} \sum_{i=1}^{n_j} (x_{ij\alpha} - \bar{x}_{j\alpha})(x_{ij\beta} - \bar{x}_{j\beta}).$$

Then a necessary condition for the criterion ratio to be maximized is satisfaction of the relation:

Monograph Supplement 4-V19 (1964), p. 908.

$$\vec{\lambda} S = \vec{x}.$$

If S possesses an inverse, the weights are given by

$$\vec{\lambda} = \vec{x} S^{-1}.$$

The weights given by the formula, $\vec{\lambda} = xS^{-1}$, are the appropriate weights for classifying individual cases from corresponding indicator values. The weights depend, however, on the variances of the indicators and fail to yield assessment of the contribution of an indicator to the discriminant function. In order to determine which indicators yield or fail to yield important information, the problem must be posed in a normed form. Accordingly we let

$$S^{*} = \sqrt{S}_{jk}\ \delta_{jk},$$

where δ_{jk} is Kronecker's delta, and define

$$R = S^{*-1} S\ S^{*-1}.$$

Then $S = S^{*}\ RS^{*}$ and the formula

$$\vec{\lambda} S = \vec{x} \text{ becomes:}$$

$$\vec{\lambda} S^{*} R = \vec{x} S^{*-1}.$$

If we define

$$\vec{K} = \vec{\lambda} S^{*} \text{ and } \vec{y} = \vec{x} S^{*-1},$$

we have the normed problem:

$$\vec{K} R = \vec{y},$$

with the solution

$$\vec{K} = \vec{y} R^{-1},$$

provided that R^{-1} exists (the matrix must invert).

The solution vector K is independent of the variances. Its components may be compared in size. Large absolute values of K represent indicators that are important in the differentiation. These are the discriminant functions.

In the evaluation of the factors influencing successful location and establishment of area vocational schools, the discriminant analysis function was programmed on the New Mexico State University Computer

Center's International Business Machines Model 1130 computer and checked on a Control Data Corporation Model 3300 computer.

The means of each group are summarized in Tables XVII and XVIII. Discriminant function coefficients for each variable in Group I and Group II are shown in Table XIX. In calculating discriminant function coefficients, shown in Table XIX, the quantitative value of all thirteen variables were used. Therefore, each variable provided its contribution to the total discriminant scores based on the value of its coefficient.

The discriminant function coefficients for six variables are shown in Table XX. The variables used in this Table are (1) anticipated first year enrollment in high schools within the area vocational school; (2) grade nine through twelve enrollment in high schools within the area vocational school district; (3) five-year projected grade nine through twelve enrollment in high schools within the area vocational school district; (4) total population within the proposed district; (5) categories of skills needed in the district; and (6) categories of programs offered anticipated the first year of operation.

By comparing the difference between the discriminant function coefficients listed in Table XX and those in Table XIX, the effect of interaction may be noted. The discriminant function coefficients in Table XX were affected by five other variables, while in Table XIX, each coefficient was affected by twelve others.

The discriminant function coefficients for four variables--anticipated first year enrollment in an area vocational school, grade nine through twelve enrollment in high schools in the area vocational school district, five-year projected enrollment in high schools in the area vocational school district, and total population within the proposed district--are shown in Table XXI. The quantitative value of the discriminant function coefficients differ from those shown in Tables XIX and XX because of the unique effect on each variable.

Shown in Table XXII are also the discriminant function coefficients of four variables. The values of the coefficients differ from those shown in Table XXI because four different variables are used.

TABLE XVII

MEANS OF THIRTEEN VARIABLES IN GROUP I

Variable	Mean
Anticipated first year enrollment in an area vocational school.	93.72727
Enrollment in grades 9-12 in high schools within the proposed area vocational school district.	1984.22729
Five year projected enrollment in grades 9-12 in high schools within the proposed area vocational school district.	2648.95459
Total population within the proposed area vocational school district.	42173.73448
Estimated size of staff during the first year in an area vocational school.	7.54545
Distance to another vocational school.	60.54545
Categories of skills needed within the proposed area vocational school district.	6.36363
Categories of anticipated programs offered first year in an area vocational school.	2.90909
Primary control - state or local.	1.68181
Percentage of support from Federal allocation.	41.95455
Percentage of support from state allocation.	35.90909
Percentage of support from local levies.	13.00000
Percentage of support from tuition.	9.13636

TABLE XVIII

MEANS OF THIRTEEN VARIABLES IN GROUP II

Variable	Mean
Anticipated first year enrollment in an area vocational school.	209.34722
Enrollment in grades 9-12 in high schools within the proposed area vocational school district.	5733.16700
Five year projected enrollment in grades 9-12 in high schools within the proposed area vocational school district.	7356.08399
Total population within the proposed area vocational school district.	160822.09417
Estimated size of staff during the first year in an area vocational school.	13.09722
Distance to another vocational school.	68.47222
Categories of skills needed within the proposed area vocational school district.	6.77777
Categories of anticipated programs offered first year in an area vocational school.	4.22222
Primary control - state or local.	1.75000
Percentage of support from Federal allocation.	33.86111
Percentage of support from state allocation.	38.44445
Percentage of support from local levies.	16.22222
Percentage of support from tuition.	11.47222

TABLE XIX

DISCRIMINATE FUNCTION COEFFICIENTS FOR THIRTEEN VARIABLES

Variable	Coefficients Group I	Coefficients Group II
Anticipated first year enrollment in an area vocational school	0.02299	0.01917
Enrollment in grades 9-12 in high schools within the proposed area vocational school district	-0.00117	-0.00065
Five year projected enrollment in grades 9-12 in high schools within the proposed area vocational school district	-0.00023	-0.00034
Total population within the proposed area vocational school district	0.00000	0.00001
Estimated size of staff during the first year in an area vocational school	-0.20965	-0.15021
Distance to another vocational school	0.07826	0.08646
Categories of skills needed within the proposed area vocational school district	3.69794	3.42661
Categories of anticipated programs offered first year in an area vocational school	1.06883	1.72973
Primary control - state or local	28.53627	26.89922
Percentage of support from Federal allocation	128167.62521	128167.56271
Percentage of support from state allocation	128167.20333	128167.18771
Percentage of support from local levies	128166.64080	128167.64080
Percentage of support from tuition	128166.79705	128166.82830
Constant	6408387.01367	6408383.01171

TABLE XX

DISCRIMINANT FUNCTION COEFFICIENTS FOR SIX VARIABLES

Variable	Coefficients Group I	 Group II
Anticipated first year enrollment in an area vocational school	0.00034	-0.00068
Enrollment in grades 9-12 in high schools within the proposed area vocational school district	-0.00035	0.00010
Five year projected enrollment in grades 9-12 in high schools within the proposed area vocational school district	-0.00909	-0.02375
Total population within the proposed area vocational school district	0.00278	0.01193
Categories of skills needed within the proposed area vocational school district	2.64262	2.53577
Categories of anticipated programs offered first year in an area vocational school	1.61206	2.19971
Constant	-10.35770	-13.53206

TABLE XXI

DISCRIMINANT FUNCTION COEFFICIENTS FOR FOUR VARIABLES

	Coefficients	
Variables	Group I	Group II
Anticipated first year enrollment in an area vocational school	0.00173	0.00197
Enrollment in grades 9-12 in high schools within the proposed area vocational school district	0.00028	0.00077
Five year projected enrollment in grades 9-12 in high schools within the proposed area vocational school district	-0.00005	-0.00020
Total population within the proposed area vocational school district	-0.00000	0.00001
Constant	-0.27926	-2.27970

TABLE XXII

DISCRIMINANT FUNCTION COEFFICIENTS FOR FOUR VARIABLES

Variable	Coefficients Group I	 Group II
Enrollment in grades 9-12 in high schools within the proposed area vocational school district	-0.00020	0.00031
Five year projected enrollment in grades 9-12 in high schools within the proposed area vocational school district	-0.00762	-0.02275
Total population within the proposed area vocational school district	0.00289	0.01126
Categories of skills needed within the proposed area vocational school district	2.62739	2.52504
Constant	-8.11994	-9.50698

The discriminant analysis program provided a score, called the Mahalanobis D-Square, which is a method for determining the significance of the difference between Group I and Group II. Rao describes the procedure by which significance may be determined.[20]

The Mahalanobis D-Square associated with the variables shown in Table XIX was 64.61915. When Rao's procedure for determining significance was employed, an F-Ratio of 82.16971 was obtained. Using 13 and 80 degrees of freedom, this F-Ratio was significant at the 0.005 level of confidence. That is, the differences between Group I and Group II could occur due to chance less than five times in one-thousand.

The significance of the differences between the characteristics of Group I and Group II were also calculated using the variables shown in Tables XX, XXI, and XXII, and in each case there were differences significant at the 0.005 level of confidence.

The calculations of the F-Ratio for each of the combinations of variables are shown in Appendix I.

Application of the Discriminant Analysis

Application of the discriminant analysis procedure to predict the likelihood that an area could successfully support a vocational school is accomplished by (1) obtaining quantitative data relative to the variables applicable to the proposed area vocational school district; (2) multiplying the quantitative value of each variable by the discriminant coefficient for that variable for Group I and Group II; (3) adding the constant for Group I and Group II; and (4) determining the sums of Group I and Group II.

The proposed area vocational school is classified in Group I if the Group I score is larger, and in Group II if the Group II score is larger. A large difference between the scores indicates a greater probability that the classification is correct, whereas, a small difference results in a lower probability.

The probability that the relative success of the proposed school has been correctly predicted may be calculated by using a procedure explained by Dixon.[21] This probability is an exponential function of the differences between groups as shown in the formula:

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[20] Rao, op.cit., p. 247.

$$P_L = \frac{1}{\sum_{K^*=1}^{g} e^{(f_{K^*} - f_L)}}.$$

A convenient means of applying the discriminant function procedure is shown in Table XXIII. The proposed area vocational school shown in this Table is classified as less successful. The probability calculation below the Table indicates that this classification would be correct more than ninety-five times in a hundred.

An application of the discriminant function procedure to an area vocational school classified as successful is shown in Table XXIV. The probability calculation below the Table indicates that this classification would be correct more than ninety-nine times in a hundred.

In the programming of the discriminant analysis for computer analysis, it was necessary to scale the input data relative to the sample variables to four absolute numbers. Therefore, in applying the model, the quantitative values of the variables must be similarly scaled when multiplying the variable data by the discriminant coefficient.

It is seen in Chapter III that the probable success of a potential area vocational school district can be calculated based upon certain quantitative descriptions. However, it should be emphasized that criteria not included in the model such as community attitudes, and political expediency must be considered prior to the arrival at a final decision in locating a particular school. Two New Mexico Areas, Albuquerque and Las Cruces, have been classified using approximate data. These classifications are located in Appendix J. The discriminant function classifications of these two areas indicate that both would be successful. The calculated probability of

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[21] W. J. Dixon (ed.), BIOMED Corporation Program Manual. (Los Angeles: University of California at Los Angeles, 1965), p. 202.

TABLE XXIII

APPLICATION OF THE DISCRIMINANT FUNCTION FOR THE CLASSIFICATION OF A LESS SUCCESSFUL SCHOOL

Variable	Quantitative value of variable (Scaled)	Discriminant coefficient of Group I-less successful	Variable value multiplied by Group I coefficient	Discriminant coefficient of Group II successful	Variable value multiplied by Group II coefficient
First Year Enrollment	97	.00034	.03298	-.00068	-.06596
Anticipated First Year 9-12 Enrollment	3785	-.00035	-1.32475	.00010	.37850
Five Year Projected 9-12 Enrollment	485	-.00909	-44.11377	-.02375	-115.25875
Total Population	7500	.00278	20.85000	.01193	89.47500
Skills Needed	7	2.64262	18.49834	2.53577	17.75039
Anticipated First Year Programs	3	1.61206	4.83618	2.19971	6.59913
		Sub-Total	-1.22102		-1.12169
		Constant	-10.35770		-13.53206
		Total	-11.57872		-14.65375

The probability of the accuracy of this classification may be computed as follows:

difference between scores = 3.07503; exponential function of 3.07503 = .04736

$$P_L = \frac{1}{\sum_{K^*=1}^{g} e\,(f_{K^*} - f_L)} = \frac{1}{1+.04736} = \frac{1}{1.04736} = 0.95478$$

TABLE XXIV

APPLICATION OF THE DISCRIMINANT FUNCTION FOR THE CLASSIFICATION OF A SUCCESSFUL SCHOOL

Variable	Quantitative value of variable (Scaled)	Discriminant coefficient of Group I-less successful	Variable value multiplied by Group I coefficient	Discriminant coefficient of Group II successful	Variable value multiplied by Group II coefficient
First Year Enrollment	1387	.00034	.47158	-.00068	-.94316
Anticipated First Year 9-12 Enrollment	9999	-.00035	-3.49965	.00010	.99990
Five Year Projected 9-12 Enrollment	1050	-.00909	-9.54450	-.02375	-24.93750
Total Population	3500	.00278	+9.73000	.01193	41.75500
Skills Needed	5	2.64262	13.21310	2.53577	12.67885
Anticipated First Year Programs	5	1.61206	8.06030	2.19971	10.99855
		Sub-Total	18.43083		40.55164
		Constant	-10.35770		-13.53206
		Grand Total	8.07313		27.01958

The probability of the accuracy of this classification may be computed as follows:

difference between the scores = 18.94645; the exponential function of 18.94645 = .00005

$$P_L = \frac{1}{\sum_{K*=1}^{g} e^{(f_{K*} - f_L)}} = \frac{1}{1+.00005} = \frac{1}{1.00005} = .99995$$

success for a school in Albuquerque is .96443 and a comparable calculation for Las Cruces is .62715.

CHAPTER IV

SUMMARY AND IMPLICATIONS

The purpose of the study was to develop a predictive model for use in locating and establishing area vocational schools. Additionally, the study was to determine the major characteristics of the model and to analyze the statistical significance of the factors comprising each of the characteristics.

The Vocational Education Act of 1963, and other federal and state legislation have had marked impact on programs of vocational education including area vocational schools. Although initial steps have been taken to extend vocational education in New Mexico, the State has fallen behind in the development of area vocational schools. The evident absence of a scientific method of locating and establishing these schools predicated a need for this study.

An extensive search through the professional literature related to industrial engineering and vocational education, and personal conferences with state and local educational leaders helped in identifying the major elements of a predictive model. A jury of thirty educators was utilized to rank the major elements in order of relative importance, and the responses were tested statistically for consensus by Kendall's Test of Concordance.

Factors comprising each major element of the model were identified and enumerated on a questionnaire. Most of the responses to the questionnaire items were obtained during site visits by the investigator to the fourteen states from which the sample schools were obtained. Other required responses were obtained by correspondence. A total of ninety-four area vocational schools comprised the sample.

Three area vocational schools in New Mexico were in operation accommodating students in the Albuquerque, El Rito, and Hobbs areas. Several programs of vocational education were offered at five state colleges and universities. Additionally, some vocational education was offered through the Manpower Development and Training Act, and approximately 1,500 students were enrolled in privately-owned vocational schools. A comprehensive statewide occupational study which was completed in 1965 indicated a need for over 68,000 vocationally trained persons during the next five year period, and programs in operation are inadequate to supply this demand.

A review of the programs of other states indicated that most terminal-type vocational education was being conducted at the post-high school level through area vocational schools. The most common factors considered by officials from other states in locating and establishing area vocational schools were high school enrollment in the area, total population in the area, administrative structure, and financial support capability. Factors least often considered were geographic radius of the proposed area vocational school district, anticipated first year enrollment in the proposed area vocational school, and distance to another vocational school.

Modular methods of explication have been utilized effectively by researchers in engineering, management, psychology, reading, and education as well as in many other disciplines, and this method was considered appropriate for this study.

Thirteen factors, based upon the review of literature and upon criteria used by other states, were selected for statistical analysis in the development of the model. The average first year enrollment of area vocational schools studied was 192 students, and the 1966 average enrollment in these schools was 411 students. The average total population of the area vocational school districts studied, excluding those operating on a statewide basis, was 162,256 in 1966, while in the first year of operation, it was 165,403.

The results of the study indicated that virtually all the graduates of area vocational schools who were available for employment had been placed. The majority were employed in the immediate geographical area.

The correlation of area vocational school offerings in relation to job opportunities in the area was significantly high in clerical and sales skills, machine trade skills, and structural skills, and fairly low in the professional, technical, and managerial skills, service skills, farming, fishing and forestry skills, and in the processing skills.

The average cost per student for one year, 1,080 hours of instruction, was $968, and capital outlay requirements were $2,310.85 per student currently enrolled. The average assessed valuation of the area vocational school districts studied, excluding statewide schools, was $232,688,007.

Approximately sixty per cent of the area vocational schools charged tuition averaging approximately $90 per year. An average of eleven per cent of the revenue of the schools studied was derived from tuition and fees. Fourteen per cent was derived from local levies and the balance was derived in essentially equal amounts from state and federal sources.

The discriminant analysis procedure was used to analyze the data because it provided (1) a method for determining significant differences between characteristics of successful and less successful area vocational schools; (2) a means of classification of individual schools into one of the groups; and (3) a model which will permit educators to predict whether or not a particular district could successfully support a vocational school.

Each of the area vocational schools which comprised the sample was classified by the respective state directors of vocational education and the investigator as highly successful or less successful based upon the current scope and apparent success of the programs of the school.

The model developed was then applied to two communities in New Mexico in order to predict whether or not they could successfully support an area vocational school.

An attempt to predict the classification of these schools from knowledge of each of the variables considered important in the successful location of area vocational schools proved to be relatively unsuccessful when the variables were applied independently.

However, discriminant analysis performed on these data revealed that discrimination between successful and less successful schools could be accomplished by utilizing various combinations of the thirteen characteristics of the district in which the school is located.

When the discriminant function model was applied to the sample of area vocational schools, it was found that the classifications by the respective state directors of vocational education and the investigator coincided with the classifications by the model in 86.17 per cent of the instances using thirteen variables; in 79.79 per cent of the instances using six variables; in 73.40 per cent of the instances using one combination of four variables; and in 74.47 per cent of the instances using another combination of four variables.

I. IMPLICATIONS

Models such as the one developed in this study can be used by educators as analogues representing processes or systems under study.

In the event that it is impossible or undesirable to manipulate the actual system or process under investigation such a model makes it possible to determine how changes in certain characteristics of the system affect other characteristics and the model as a whole. Such an understanding of the dynamics of the system permits prediction as to the effect of changes on the system. Therefore, where alternative courses of action exist, the use of a model such as the one developed in this study permits an assessment of the probable outcome of a decision to pursue each of the alternative courses of action.

Although the decision must still be made as to which alternative to pursue; nevertheless, the decision-maker is provided with an estimate as to the probable outcome of his decision.

This study indicates that in the past policy-makers in education have not taken advantage of the many quantitative techniques available to assist them in making decisions such as deciding where to locate area vocational schools, community colleges, consolidated schools, and other institutions.

More importantly, the study demonstrates the value of constructing models of complex educational systems and programs in order to assist policy-makers to reach decisions regarding their development.

Through the construction, manipulation, and solution of models such as the one investigated which related the success of an area vocational school to a number of characteristics of the area in which they were established, better decisions can be made regarding educational programs.

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APPENDIX A

FACTORS RELATING TO LOCATION AND ESTABLISHMENT OF AREA VOCATIONAL SCHOOLS

FACTOR RELATING TO LOCATIONS AND ESTABLISHMENT OF AREA VOCATIONAL SCHOOLS

Please rank the following factors as to their relative importance in the geographic location of area vocational schools by inserting the letter beside each factor in the appropriate blank under RANK.

RANK

1. ____________
2. ____________
3. ____________
4. ____________
5. ____________
6. ____________
7. ____________
8. ____________
9. ____________
10. ____________
11. ____________

FACTOR

a. Number of students by grade level enrolled in public and private schools in the area.

b. Ability to attract and hold faculty.

c. Dropout rate of schools in the area.

d. Assessed valuation of the area.

e. Industry and business in the area - planned and present.

f. Present and predicted statewide and nationwide employment opportunities for trainees from vocational and technical education programs.

g. Total and projected population of the area.

h. Present tax load in the area.

i. Distance between possible area vocational schools.

j. Can the area show need (present need plus expansion plus turnover) in at least five divisions of vocational/technical education?

k. Finance resource potential of the area. (In addition to that based upon assessed valuation of the area.)

Comments:

APPENDIX B

INDIVIDUALS WHO SERVED AS JURY MEMBERS IN RANKING THE MAJOR CHARACTERISTICS OF THE MODEL

INDIVIDUALS WHO SERVED AS JURY MEMBERS IN RANKING THE MAJOR CHARACTERISTICS OF THE MODEL

Walter Arnold, Director
Division of Vocational and
Technical Education
U. S. Office of Education

Thurman J. Bailey, Director
Vocational, Technical, and
Adult Education
Florida State Department of Education

George Bennet, Director
Area Vocational-Technical Schools
Kansas State Department of Education

Rodney Berg, President
Everette Community College
Everette, Washington

Albert Bettina
Professor and Chairman of the
Division of Vocational Education
Eastern New Mexico University

John H. Blackmon
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Education

M. A. Browning
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and Welfare
Dallas, Texas

Henry Campbell, Jr., President
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John Coester, Director
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North Carolina State University

C. C. Colvert
Professor and Consultant in
Junior College Education
The University of Texas

J. Wayne Courtney
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University of Nebraska

R. L. Johns
Professor of Educational
Administration
Florida State University

Jack Lacey, Program
Specialist, Bureau of Adult
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Junior College Education
University of California at
Berkeley

William P. Miller, President
Weber State College
Ogden, Utah

William Mortimer
Professor of Industrial Education
Utah State University

Duane Nielsen, Director
Educational Resources
Development Branch
Office of Education
Department of Health, Education,
and Welfare
Washington, D.C.

Jack Nix, State Superintendent
Georgia State Department of
Education

Earl Nunn, Superintendent
Las Cruces Public Schools
Las Cruces, New Mexico

William B. O'Donnell, Vice-President
New Mexico State University

H. C. Pannell, President
New Mexico Junior College

Michael Russo, Director
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R. M. Tomlinson, Chairman
Industrial Education Division
Education Building
University of Illinois

Francis Tuttle, Coordinator
Area Vocational-Technical
Schools, State Board for
Vocational Education
Stillwater, Oklahoma

APPENDIX C

CALCULATIONS OF KENDALL'S W

TABLE XXV

CALCULATIONC OF KENDALL'S W USING ELEVEN FACTORS AND THIRTY JUDGES[+]

Respondent	Factors										
	A	B	C	D	E	F	G	H	I	J	K
1	2	11	3	10	5	7	4	9	8	1	6
2	2	9	6	11	3	1	4	10	7	5	8
3	1	11	2	7	5	4	3	6	10	9	8
4	2	10	8	1	9	11	6	5	4	3	7
5	2	10	11	5	7	1	3	4	9	8	6
6	3	11	10	1	6	5	4	8	9	7	2
7	1	3	4	2	1	1	1	2	2	1	2
8	10	1	11	9	6	2	5	8	3	4	7
9	3	9	8	6	2	1	4	7	10	11	5
10	5	6	1	9	10	7	2	11	3	4	8
11	4	7	5	2	8	9	1	3	11	10	6
12	2	5	4	1	8	9	3	6	7	10	11
13	1	4	3	9	6	7	2	10	5	8	11
14	1	7	8	10	4	6	2	11	5	3	9
15	4	10	6	2	8	7	5	3	11	9	1
16	1	10	4	8	7	2	5	9	11	3	6
17	2	11	3	10	5	7	4	9	8	1	6
18	2	7	3	9	8	4	1	11	6	5	10
19	1	11	10	2	3	6	4	7	9	8	5
20	2	5	9	4	3	11	11	6	8	10	7
21	3	7	6	10	5	4	8	11	9	1	2
22	5	6	7	8	3	11	2	10	1	4	9
23	1	3	5	6	4	8	2	7	10	11	9
24	2	11	3	10	5	7	4	9	8	1	6
25	2	10	9	6	4	5	3	3	11	1	7

TABLE XXV (continued)

Respondent	Factors										
	A	B	C	D	E	F	G	H	I	J	K
26	1	5	6	9	3	4	2	10	7	8	11
27	1	8	10	5	2	3	4	9	7	11	6
28	9	10	8	1	5	7	3	2	11	6	4
29	2	11	3	10	5	7	4	9	8	1	6
$\left[\frac{\Sigma R_j}{N} = 169.82\right] R_j =$	77	229	176	183	150	164	96	220	218	164	191
$R_j \frac{\Sigma R_j}{N} =$	-92.82	59.18	6.18	13.18	-19.82	-5.82	-73.82	50.18	48.18	-5.82	21.18
$(R_j - \frac{\Sigma R_j}{N})^2 =$	8615.55	3502.27	38.19	173.71	392.83	33.87	5449.39	2518.03	2321.31	33.87	448.59

$$S = \Sigma (R_j - \frac{\Sigma R_j}{N})^2 = 23,527.61 = 23,528$$

$$W = \frac{S}{1/12\ K^2(N^3-N)} = \frac{23,528}{1/12(29)^2(11^3-11)} = \frac{23,528}{1/12(841)(1320)} = \frac{23,528}{1/12(1,110,120)} = \frac{23,528}{92,510} = 0.254$$

$$x^2 = K(N-1)\ W = 29(11-1).254 = (290)(.254) = 73.66$$

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[a] One judge declined to rank the factors, thus N = 29.

TABLE XXVI

CALCULATION OF KENDALL'S W WHEN ELEVEN FACTORS ARE REDUCED TO THREE MAJOR CHARACTERISTICS

Respondent	Input potential (factors acg)	Market for graduates (factors efj)	Financial support (factors dhk)
1	9	13	25
2	7	9	29
3	6	18	21
4	16	23	13
5	16	16	15
6	17	18	11
7	6	3	6
8	26	12	23
9	15	14	18
10	8	21	28
11	10	27	11
12	9	27	18
13	6	21	30
14	11	13	30
15	15	24	6
16	10	12	23
17	9	13	25
18	6	17	30
19	15	17	14
20	12	24	17
21	17	10	23
22	14	18	27
23	8	23	22
24	9	13	25
25	14	10	20

TABLE XXVI (continued)

Respondent	Input Potential (factors acg)	Market for Graduates (factors efj)	Financial Support (factors dhk)
26	9	15	30
27	15	16	20
28	20	18	7
29	9	13	25
$\left[\frac{\sum R_j}{N} = 471.33\right]$ R_j	344	478	592
$R_j - \frac{\sum R_j}{N} =$	-127.33	6.67	120.67
$(R_j - \frac{\sum R_j}{N})^2 =$	16212.93	44.49	14561.25

$$S = \sum(R_j - \frac{\sum R_j}{N})^2 = 30,818.67 = 30,819$$

$$W = \frac{S}{1/12\ K^2\ (N^3-N)} = \frac{30,819}{1/12\,(29)^2\,(11^3-11)} = \frac{30,819}{1/12\,(1,110,120)} = \frac{30,819}{92,510} = 0.333$$

$$x^2 = K(N-1);\ W = 29\ (11-1).333 = (290)\ (.333) = 96.57$$

APPENDIX D

QUESTIONNAIRE RELATING TO ESSENTIAL INFORMATION PERTINENT TO LOCATION AND ESTABLISHMENT OF AREA VOCATIONAL SCHOOLS

NEW MEXICO STATE UNIVERSITY
College of Teacher Education
Department of Educational Administration

Essential Information Pertinent to Location and Establishment of Area Vocational Schools

It is recognized that the terms "vocational" and "technical" are used interchangeably in some geographical areas and differently in others. If you use only one of these terms, delete the other in the questionnaire.

SECTION I

Name of School ____________________

Name of Respondent ____________________

Address ____________________

Telephone Number ____________________

SECTION II

Year your vocational-technical school opened. ________

May I call you and discuss additional facets of your operations? Yes _____ No_____

May I visit your school and test the model in your area? Yes _____ No_____

SECTION III

1. What is the present total enrollment in your vocational and/or technical courses? Technical _____ Vocational _____
2. What was the total enrollment in your vocational and/or technical courses in the first year of operation as an area vocational-technical school? Technical _____ Vocational _____
3. What is the total number of students in grades 9-12, inclusive, presently enrolled in high school (s) within the geographic boundaries of your area? ____________
4. What was the total number of students in grades 9-12, inclusive, enrolled in the high school (s) in your first year of operation as an area vocational-technical school? ____________
5. In your first year of operation, what was the projected number of students in grades 9-12 inclusive, five years after operation? ____________

6. What is the present total estimated population within the geographic boundaries of your area vocational-technical school? ________________

7. What was the total estimated population within the geographic boundaries of your area vocational-technical school district in the first year of operation? ________________

8. In your first year of operation what was the projected population within the boundaries of your area vocational-technical school district five years later? ________________

9. Excluding capital outlay, approximately what is the average total cost per student over a 12 month period? ________________

10. Has this cost increased or decreased since your first year of operation? How Much? ________________
____

11. What is the approximate capitalized value of your area vocational school? ________________

12. Is your area vocational-technical school connected administratively with another administrative entity? Yes ______ No_____

If yes, please check one:

Community College ______
Junior College ______
Senior College ______
High School ______
State Operated ______
Other (identify) ______

____

13. What was the assessed valuation of your area vocational-technical school district in the first year of operation? ________________

14. What is the present assessed valuation of your area vocational-technical school district? ________________

15. In your first year of operation, what was the projected assessed valuation five years later? ______________

16. Approximately what percentage of your area vocational-technical school revenue is obtained by:

	Now	When you first started
Tuition	_____%	_____%
Local Tax	_____%	_____%
State Support	_____%	_____%
Federal	_____%	_____%
Other (specify)	_____%	_____%
____________	_____%	_____%

17. What is the main source of student support now and when you first started?

Percentage of students who obtain some help from:

	Now	When you first started
Federal scholarships.	_____%	_____%
State scholarships.	_____%	_____%
Local aid.	_____%	_____%
Loans.	_____%	_____%
Work-study Programs	_____%	_____%
Other (identify)	_____%	_____%
17.a. Percentage of students who have no outside aid.	_____%	_____%

	Now	When you first started
18. How many full-time equivalent teachers are there on your faculty? (A full-time equivalent teacher is one who spends the major portion of the day teaching)	_______	_______

19. How many of the faculty members have been on your faculty:

	Number
Less than one year	________
One year	________
Two years	________
Three years	________
Four Years	________
Five Years	________
More than five years	________

20. How many of these faculty members have completed a:

	Number
Doctorate	______
Master's Degree	______
Bachelor's Degree	______
Less than Bachelor's	______
Appropriate Trade School	______
Union and/or apprentice program	______
Other (identify)	______

21. Based on a graduating class:

	1966	Your first graduating class
What per cent are employed in your geographic proximity?	_____%	______%
What per cent are employed outside your geographic proximity but within the State?	_____%	______%
What per cent are unemployed?	_____%	______%

	Now	When you first started
22. Approximately what per cent of your students dropout of the vocational-technical program before completion of the course in which they are enrolled?	_____%	______%
23. Approximately what percent of your enrollment did not complete high school?	______%	______%
24. Approximately what per cent of your enrollment is not enrolled in high school but will probably drop out of high school?	______%	______%

25. What types of programs were offered in your school when you first started and what programs are offered now?

Check appropriate blanks:

	Now	When you first started
Professional, technical, managerial (occupations in education, writing, art, etc.)	_______	_______

	Now	When you first started
Clerical and sales (secretarial, typing, salesmen, etc.)	_______ _______	_______ _______
Service (domestic service, food and beverage preparation, barbering, etc.)	_______	_______
Farming, fishery, forestry (farming occupations, fishery, forestry)	_______	_______
Processing (processing of metal, ore refining, paper, leather processing, etc.)	_______	_______
Machine trades (printing, lathe operation, mechanics, etc.)	_______	_______
Bench Work (fabrication of wood, plastic, rubber products, etc.)	_______	_______
Structural work (carpentry, masonry, etc.)	_______	_______
Miscellaneous (specify)	_______	_______
	_______	_______
	_______	_______
	_______	_______

26. What types of job opportunities are available in your geographic proximity and what was available when you first started?

Check appropriate blanks:

	Now	When you first started
Professional, technical, managerial	_______	_______
Clerical and sales	_______	_______

26. (continued)	Now	When you first started
Service	______	______
Farming, fishery, forestry	______	______
Processing	______	______
Machine Trades	______	______
Bench Work	______	______
Structural Work	______	______
Miscellaneous (specify)	______	______

	Location	Distance
27. How far is the nearest vocational-technical school when you first started?	______	______

	Location	Distance
28. How far was the nearest vocational-technical school when you first started?	______	______

	Now	When you first started
29. a. Do you provide dormitory facilities?	______	______

	Now	When you first started
b. If yes, how many students live in dormitories?	______	______

30. Was your vocational-technical school or program in operation when you were designated as an area vocational-technical school?

Yes ______ No ______

Comments: (continue on back, if necessary)

APPENDIX E

STATES IN WHICH AREA VOCATIONAL SCHOOLS COMPRISING THE SAMPLE WERE LOCATED

TABLE XXVII

STATES IN WHICH AREA VOCATIONAL SCHOOLS COMPRISING THE SAMPLE WERE LOCATED

States	Number of schools
Arizona	4
Arkansas	8
Colorado	1
Georgia	6
Idaho	4
Iowa	16
Kansas	7
Minnesota	15
Nevada	1
North Carolina	15
Oklahoma	2
Texas	6
Utah	2
Wisconsin	7
Total	94

APPENDIX F

DISCRIMINANT FUNCTION CLASSIFICATION OF THE SAMPLE AREA VOCATIONAL SCHOOLS

TABLE XXVIII

DISCRIMINANT FUNCTION CLASSIFICATION OF THE SAMPLE AREA VOCATIONAL SCHOOLS IN GROUP I USING ALL THIRTEEN VARIABLES +

Observation number	Probability associated with largest discriminant function	Largest function number
1	0.73105	2
2	0.73105	1
3	0.73105	1
4	0.73105	2
5	0.98201	1
6	0.73105	2
7	0.73105	2
8	0.88079	1
9	0.50000	1
10	0.73105	1
11	0.73105	2
12	0.73105	1
13	0.50000	1
14	0.50000	1
15	0.50000	1
16	0.73105	1
17	0.88079	1
18	0.99330	1
19	0.98201	1
20	0.88079	1
21	0.88079	1
22	0.95257	1

+Schools classified as less successful by the respective state directors of vocational education and the investigator.

TABLE XXIX

DISCRIMINANT FUNCTION CLASSIFICATION OF THE SAMPLE AREA VOCATIONAL SCHOOLS IN GROUP II USING ALL THIRTEEN VARIABLES[+]

Observation number	Probability associated with largest discriminant function	Largest function number
1	0.99330	2
2	0.99966	2
3	0.99908	2
4	0.99752	2
5	0.99330	2
6	0.88079	2
7	0.95257	2
8	0.99908	2
9	0.99908	2
10	0.73105	2
11	0.99752	2
12	0.99908	2
13	0.73105	2
14	0.98201	2
15	0.73105	2
16	0.73105	2
17	0.95257	2
18	0.50000	1
19	0.73105	2
20	0.95257	2
21	0.98201	2
22	0.98201	2
23	0.99752	2
24	0.50000	1
25	0.98201	2
26	0.88079	2
27	0.73105	2

TABLE XXIX (continued)

Observation number	Probability associated with largest discriminant function	Largest function number
28	0.98201	2
29	0.88079	2
30	0.88079	1
31	0.95257	2
32	0.88079	2
33	0.99330	2
34	0.50000	1
35	0.95257	2
36	0.99752	2
37	0.95257	2
38	0.98201	2
39	0.98201	2
40	0.88079	2
41	0.98201	2
42	0.99752	2
43	0.99752	2
44	0.99752	2
45	0.99330	2
46	0.99966	2
47	0.99995	2
48	0.73105	2
49	0.98201	2
50	0.99908	2
51	0.99987	2
52	0.99330	2
53	0.95257	2
54	0.98201	2
55	0.88079	2
56	0.88079	2

TABLE XXIX (continued)

Observation number	Probability associated with largest discriminant function	Largest function number
57	0.95257	2
58	0.99330	2
59	0.88079	2
60	0.95257	2
61	0.99330	2
62	0.73105	1
63	0.88079	2
64	0.50000	1
65	0.95257	2
66	0.88079	2
67	0.73105	2
68	0.50000	1
69	0.73105	2
70	0.73105	1
71	0.88079	2
72	0.99752	2

+Schools classified as successful by the respective state directors of vocational education and the investigator.

TABLE XXX

DISCRIMINANT FUNCTION CLASSIFICATION OF THE SAMPLE AREA VOCATIONAL SCHOOLS IN GROUP I USING SIX VARIABLES:

Anticipated first year enrollment in an area vocational school.

Enrollment in grades 9-12 in high schools within the proposed area vocational school district.

Five year projected enrollment in grades 9-12 in high schools within the proposed area vocational school district.

Total population within the proposed area vocational school district.

Categories of skills needed within the proposed area vocational school district.

Categories of anticipated programs offered first year in an area vocational school.

Observation number	Probability associated with largest discriminant function	Largest function number
1	0.63906	1
2	0.61050	1
3	0.78283	1
4	0.87296	1
5	0.72961	1
6	0.62056	2
7	0.69806	1
8	0.86750	1
9	0.81026	1
10	0.92872	1
11	0.80928	1
12	0.77234	1
13	0.70973	1
14	0.70388	1
15	0.83489	1

TABLE XXX (continued)

Observation number	Probability associated with largest discriminant function	Largest function number
16	0.70354	1
17	0.74675	1
18	0.95432	1
19	0.90459	1
20	0.81968	1
21	0.89132	1
22	0.77861	1

TABLE XXXI

DISCRIMINANT FUNCTION CLASSIFICATION OF THE SAMPLE AREA VOCATIONAL SCHOOLS IN GROUP II USING SIX VARIABLES:

Anticipated first year enrollment in an area vocational school.

Enrollment in grades 9-12 in high schools within the proposed area vocational school district.

Five year projected enrollment in grades 9-12 in high schools within the proposed area vocational school district.

Total population within the proposed area vocational school district.

Categories of skills needed within the proposed area vocational school district.

Categories of anticipated programs offered first year in an area vocational school.

Observation number	Probability associated with largest discriminant function	Largest function number
1	0.84980	2
2	0.95400	2
3	0.98236	2
4	0.63427	2
5	0.77238	2
6	0.61674	2
7	0.68799	2
8	0.96301	2
9	0.92442	2
10	0.53576	2
11	0.96063	2
12	0.98806	2
13	0.59367	1
14	0.89121	2
15	0.59905	2
16	0.82302	2

TABLE XXXI (continued)

Observation number	Probability associated with largest discriminant function	Largest function number
17	0.94547	2
18	0.84778	2
19	0.78841	2
20	0.75038	2
21	0.89357	2
22	0.79695	2
23	0.98118	2
24	0.78879	1
25	0.91235	2
26	0.70122	2
27	0.59925	1
28	0.91174	2
29	0.51315	2
30	0.78595	1
31	0.58391	2
32	0.59375	2
33	0.86003	2
34	0.59946	1
35	0.55832	1
36	0.82853	2
37	0.86891	2
38	0.96787	2
39	0.95229	2
40	0.82857	1
41	0.94077	2
42	0.88172	2
43	0.96553	2
44	0.93478	2
45	0.94292	2
46	0.97077	2

TABLE XXXI (continued)

Observation number	Probability associated with largest discriminant function	Largest function number
47	0.99812	2
48	0.84730	2
49	0.90738	2
50	0.98745	2
51	0.99607	2
52	0.84653	2
53	0.62741	2
54	0.62179	2
55	0.77808	2
56	0.77446	1
57	0.50524	1
58	0.93550	2
59	0.53593	1
60	0.51912	1
61	0.91194	2
62	0.80035	1
63	0.60306	1
64	0.90864	1
65	0.57496	2
66	0.79109	1
67	0.51361	1
68	0.89153	1
69	0.54938	2
70	0.73097	1
71	0.52834	2
72	0.98175	2

TABLE XXXII

DISCRIMINANT FUNCTION CLASSIFICATIONS OF THE SAMPLE AREA VOCATIONAL SCHOOLS IN GROUP I USING FOUR VARIABLES:

Anticipated first year enrollment in an area vocational school.

Enrollment in grades 9-12 in high schools within the proposed area vocational school district.

Five year projected enrollment in grades 9-12 in high schools within the proposed area vocational school district.

Total population within the proposed area vocational school district.

Observation number	Probability associated with largest discriminant function	Largest function number
1	0.56140	1
2	0.67372	1
3	0.55823	1
4	0.82757	1
5	0.70933	1
6	0.54395	1
7	0.68918	1
8	0.83557	1
9	0.61747	1
10	0.83240	1
11	0.52855	1
12	0.84143	1
13	0.50478	2
14	0.81917	1
15	0.82838	1
16	0.77911	1
17	0.83592	1
18	0.84100	1
19	0.77054	1
20	0.80051	1
21	0.81576	1
22	0.82043	1

TABLE XXXIII

DISCRIMINANT FUNCTION CLASSIFICATIONS OF THE SAMPLE AREA VOCATIONAL SCHOOLS IN GROUP II USING FOUR VARIABLES:

Anticipated first year enrollment in an area vocational school.

Enrollment in grades 9-12 in high schools within the proposed area vocational school district.

Five year projected enrollment in grades 9-12 in high schools within the proposed area vocational school districts.

Total population within the proposed area vocational school district.

Observation number	Probability associated with largest discriminant function	Largest function number
1	0.92346	2
2	0.91000	2
3	0.95379	2
4	0.65925	2
5	0.83529	2
6	0.51294	1
7	0.57827	2
8	0.93723	2
9	0.92707	2
10	0.52592	1
11	0.88827	2
12	0.97968	2
13	0.66892	1
14	0.86817	2
15	0.75145	2
16	0.60867	2
17	0.88491	2
18	0.84999	2
19	0.77011	2
20	0.83670	
21	0.63837	2

TABLE XXXIII (continued)

Observation number	Probability associated with largest discriminant function	Largest function number
22	0.54966	1
23	0.97436	2
24	0.57847	1
25	0.88980	2
26	0.81692	2
27	0.52389	2
28	0.96710	2
29	0.51099	1
30	0.60471	1
31	0.59193	2
32	0.67572	1
33	0.63745	2
34	0.66733	1
35	0.62071	1
36	0.93080	2
37	0.89754	2
38	0.86918	2
39	0.90632	2
40	0.73512	1
41	0.93371	2
42	0.88301	2
43	0.93401	2
44	0.88401	2
45	0.90026	2
46	0.93155	2
47	0.99531	2
48	0.86573	2
49	0.91384	2
50	0.97606	2
51	0.93411	2
52	0.72984	2

TABLE XXXIII (continued)

Observation number	Probability associated with largest discriminant function	Largest function number
53	0.61117	2
54	0.79370	2
55	0.78439	2
56	0.77868	1
57	0.78656	1
58	0.77965	2
59	0.63928	1
60	0.76422	1
61	0.89516	2
62	0.83209	1
63	0.76573	1
64	0.76534	1
65	0.78254	1
66	0.76577	1
67	0.76555	1
68	0.78954	1
69	0.59596	1
70	0.52930	1
71	0.53133	2
72	0.98932	2

TABLE XXXIV

DISCRIMINANT FUNCTION CLASSIFICATIONS OF THE SAMPLE AREA VOCATIONAL SCHOOLS IN GROUP I USING FOUR VARIABLES:

Enrollment in grades 9-12 in high schools within the proposed area vocational school district.

Five year projected enrollment in grades 9-12 in high schools within the proposed area vocational school district.

Total population within the proposed area vocational school district.

Categories of skills needed within the proposed area vocational school district.

Observation number	Probability associated with largest discriminant function	Largest function number
1	0.56850	1
2	0.67203	1
3	0.58916	1
4	0.84207	1
5	0.76350	1
6	0.56090	1
7	0.65912	1
8	0.84887	1
9	0.65368	1
10	0.85976	1
11	0.51443	1
12	0.84146	1
13	0.50272	1
14	0.78597	1
15	0.81384	1
16	0.77918	1
17	0.82173	1
18	0.85215	1
19	0.70983	1
20	0.79835	1
21	0.78597	1
22	0.84686	1

TABLE XXXV

DISCRIMINANT FUNCTION CLASSIFICATIONS OF THE SAMPLE AREA VOCATIONAL SCHOOLS IN GROUP II USING FOUR VARIABLES:

Enrollment in grades 9-12 in high schools within the proposed area vocational school district.

Five year projected enrollment in grades 9-12 in high schools within the proposed area vocational school districts.

Total population within the proposed area vocational school district.

Categories of skills needed with the proposed area vocational school district.

Observation number	Probability associated with largest discriminant function	Largest function number
1	0.92082	2
2	0.92416	2
3	0.95379	2
4	0.70473	2
5	0.82357	2
6	0.54781	2
7	0.63932	2
8	0.93603	2
9	0.93265	2
10	0.53190	1
11	0.88498	2
12	0.97473	2
13	0.65858	1
14	0.85666	2
15	0.79581	2
16	0.59898	2
17	0.90591	2
18	0.84167	2
19	0.75606	2
20	0.84121	2
21	0.66967	2
22	0.50627	2
23	0.97130	2

TABLE XXXV (continued)

Observation number	Probability associated with largest discriminant functions	Largest function number
24	0.64348	1
25	0.90814	2
26	0.83327	2
27	0.50752	1
28	0.96742	2
29	0.54940	1
30	0.61327	1
31	0.65279	2
32	0.63008	1
33	0.62352	2
34	0.55374	1
35	0.62644	1
36	0.93287	2
37	0.88471	2
38	0.88782	2
39	0.89137	2
40	0.77840	1
41	0.93983	2
42	0.87963	2
43	0.93983	2
44	0.89005	2
45	0.90089	2
46	0.94461	2
47	0.99580	2
48	0.84678	2
49	0.91241	2
50	0.97607	2
51	0.93289	2
52	0.73542	2
53	0.58505	2
54	0.77656	2
55	0.77254	2
56	0.72602	1

TABLE XXXV (continued)

Observation number	Probability associated with largest discriminant function	Largest function number
57	0.82080	1
58	0.72681	2
59	0.60611	1
60	0.72756	1
61	0.88138	2
62	0.85961	1
63	0.88027	1
64	0.81613	1
65	0.78199	1
66	0.76281	1
67	0.74379	1
68	0.80300	1
69	0.55805	1
70	0.53933	1
71	0.50689	1
72	0.98939	2

APPENDIX G

SUMMARIES OF OCCUPATIONAL NEEDS IN THIRTY-TWO TOWNS IN NEW MEXICO

TABLE XXXVI

A SUMMARY OF PRESENT AND PROJECTED OCCUPATIONAL NEEDS IN FIVE AREAS FOR 32 TOWNS +

Occupational Division	Total Needs (Vacancies, plus needs, plus turnover)						
	Alamogordo	Albuquerque	Artesia	Belen	Carlsbad	Clayton	Cloudcroft
Distributive Education	511	3381	147	77	567	7	9
Office Education	212	7515	132	79	431	10	6
Trade and Industry	659	12447	310	241	1308	26	76
Agricultural Education	42	285	11	3	47	0	16
Home Economics Education	307	1776	60	60	345	16	3
Total	1731	25404	660	460	2698	59	110

	Clovis	Deming	Espanola	Farmington	Gallup	Grants	Hobbs	Las Vegas
Distributive Education	752	49	210	463	619	646	667	174
Office Education	398	67	85	420	458	259	288	197
Trade and Industry	1770	121	212	2123	1350	978	864	513
Agricultural Education	271	19	12	38	40	36	25	8
Home Economics Education	467	36	127	187	257	285	129	150
Total	3658	292	646	3231	2724	2204	1973	1042

TABLE XXXVI (continued)

Occupational Division	Total Needs (Vacancies, plus needs, plus turnover)						
	Lordsburg	Los Alamos	Los Lunas	Lovington	Portales	Raton	Roswell
Distributive Education	137	187	34	200	165	108	1010
Office Education	61	347	96	157	168	195	484
Trade and Industry	249	710	302	542	328	436	2036
Agricultural Education	3	11	18	34	43	11	202
Home Economics Education	177	63	383	93	80	130	860
Total	627	1318	833	1026	784	880	4592
	Ruidoso	Santa Fe	Santa Rosa	Silver City	Socorro	Springer	Taos
Distributive Education	133	536	++	155	121	38	120
Office Education	27	419	++	346	131	51	93
Trade and Industry	44	700	++	1274	364	103	165
Agricultural Education	0	52	++	35	19	13	8
Home Economics Education	26	298	++	34	84	39	92
Total	230	2005	++	1844	719	244	478

++ Not Obtained.

TABLE XXXVI (continued)

Occupational Division	Total Needs (Vacancies, plus needs, plus turnover)		
	Truth or Consequences	Tucumcari	Las Cruces
Distributive Education	82	69	902
Office Education	81	66	1238
Trade and Industry	266	299	2341
Agricultural Education	2	26	124
Home Economics Education	98	76	587
Total	529	536	5192

[+] James D. McComas and Darrell S. Willey, Occupational Needs for Vocational and Technical Education: New Mexico (Bureau of Educational Research Publication Number 8. New Mexico State University: Bureau of Educational Research, 1966), pp. 17-32.

TABLE XXXVII

SUMMARY OF OCCUPATIONAL NEEDS IN 32 TOWNS IN NEW MEXICO[+]

Occupational Division	Vacancies	Needed in Next 5 Years	Turn-Over	Total Needs
Distributive Education	418	5, 425	6, 433	12, 276
Office Education	466	8, 485	5, 566	14, 517
Trade and Industry	1, 279	16, 188	15, 690	33, 157
Agricultural Education	110	677	677	1, 454
Home Economics Education	204	3, 176	3, 945	7, 325
Total	2, 477	33, 951	32, 301	68, 729

[+] James D. McComas and Darrell S. Willey, _op. cit.,_ p. 33.

APPENDIX H

NEW MEXICO POPULATION PROJECTIONS BY COUNTIES TO THE YEAR 2000

TABLE XXXVIII

NEW MEXICO POPULATION PROJECTIONS BY COUNTIES TO THE YEAR 2000^{+}

		Population Projections			
County	1960 (Census)	1970	1980	1990	2000
Bernalillo	262, 199	375, 400	531, 500	712, 800	948, 000
Catron	2, 773	3, 000	4, 200	5, 900	9, 300
Chaves	56, 649	73, 300	92, 400	114, 800	151, 400
Colfax	13, 806	15, 500	18, 000	21, 500	26, 400
Curry	32, 691	45, 700	68, 100	90, 600	123, 700
De Baca	2, 991	3, 100	4, 600	6, 300	10, 100
Dona Ana	59, 948	95, 700	136, 300	168, 600	224, 000
Eddy	50, 783	55, 100	66, 500	80, 600	104, 200
Grant	18, 700	21, 200	28, 600	34, 900	44, 800
Guadalupe	5, 610	7, 500	8, 000	11, 600	16, 000
Harding	1, 874	2, 200	3, 800	5, 300	8, 100
Hidalgo	4, 961	7, 300	7, 900	8, 800	11, 800
Lea	53, 429	65, 700	84, 600	105, 000	140, 300
Lincoln	7, 744	10, 200	13, 900	18, 500	23, 900
Los Alamos	13, 037	23, 700	34, 700	42, 800	56, 300
Luna	9, 839	13, 500	17, 400	22, 700	30, 600
McKinley	37, 209	41, 400	58, 700	70, 800	88, 200
Mora	6, 028	4, 700	5, 300	6, 600	10, 200
Otero	36, 976	44, 500	60, 800	77, 500	102, 600
Quay	12, 279	15, 400	16, 200	19, 700	26, 500
Rio Arriba	24, 193	22, 200	26, 600	36, 700	43, 600
Roosevelt	16, 198	20, 400	26, 200	31, 100	38, 700

TABLE XXXVIII (continued)

Population Projections

County	1960 (Census)	1970	1980	1990	2000
Sandoval	14,201	14,800	18,600	24,300	26,500
San Juan	53,306	53,300	66,200	82,600	100,500
San Miguel	23,468	25,400	30,100	36,700	49,000
Santa Fe	44,970	58,500	82,200	122,200	178,500
Sierra	6,409	7,900	9,900	12,500	18,000
Socorro	10,168	10,600	12,700	15,700	21,200
Taos	15,934	18,600	24,800	31,800	37,900
Torrance	6,497	6,000	6,500	8,000	10,400
Union	6,068	7,300	7,200	8,200	10,800
Valencia	39,085	38,900	57,500	75,900	86,600
Totals	951,023	1,208,000	1,630,000	2,111,000	2,778,000

+Ralph L. Edgel, op. cit., pp. 10-11.

APPENDIX I

CALCULATION OF THE SIGNIFICANCE OF MAHALANOBIS' D-SQUARE BY F-RATIO TECHNIQUE

Calculation of the Significance of Mahalanobis' D-Square by F-Ratio Technique[+]

I. Significance of Mahalanobis' D-Square between Groups I and II using all thirteen variables: $D^2 = 64.61915$

$$F \text{ @ } (m,\ n_1+n_2-1-m) = \frac{n_1 n_2 (n_1+n_2-m-1)}{m(n_1+n_2)(n_1+n_2-2)} \cdot D^2_{13} =$$

$$13, (22+72-1-13) = \frac{(22)(72)(22+72-13-1)}{13(22+72)(22+72-2)} \cdot 64.61915 =$$

$$13, 80 = 1.12716 \cdot 64.61915 = 82.16971^{**}$$

$P_{.005} = 2.74$ @ 12, 60 df; 2.54 @ 12, 120 df.

[+] Rao, op. cit., p. 247.

II. Significance of Mahalanobis' D^2 with the following variables:

Anticipated first year enrollment in an area vocational school.

Enrollment in grades 9-12 in high schools within the proposed area vocational school district.

Five year projected enrollment in grades 9-12 in high schools within the proposed area vocational school district.

Total population within the proposed area vocational school district.

Categories of skills needed within the proposed area vocational school district.

Categories of anticipated programs offered first year in an area vocational school: $D^2 = 45.38275$.

$$F \ @ \ (m, \ n_1+n_2 - 1 - m) = \frac{n_1 n_2 (n_1+n_2-m-1)}{m(n_1+n_2)(n_1+n_2-2)} \cdot D^2_6$$

$$6, \ (22+72-1-6) = \frac{22 \cdot 72(22+72-6-1)}{6(22+72)(22+72-2)} \cdot 45.38275 =$$

$$6, 87 = 2.65587 \cdot 45.38275 = 120.53068^{**}$$

$$P_{.005} = 3.49 \ @ \ 6, 60 \text{ df}; \ 3.28 \ @ \ 6, 120 \text{ df}.$$

III. Significance of Mahalanobis' D^2 with the following variables:

Anticipated first year enrollment in an area vocational school.

Enrollment in grades 9-12 in high schools within the proposed area vocational school district.

Five year projected enrollment in grades 9-12 in high schools within the proposed area vocational school district.

Total population within the proposed area vocational school district: $D^2 = 35.81660$

$$F \text{ @ } (m, \quad n_1+n_2-1-m) = \frac{n_1 n_2 (n_1+n_2-m-1)}{m(n_1+n_2)(n_1+n_2-2)} \cdot D_4^2 =$$

$$4, \quad (22+72-1-4) = \frac{22 \cdot 72(22+72-4-1)}{4(22+72)(22+72-2)} \cdot 35.81660 =$$

$$4, 89 = 4.07539 \cdot 35.81660 = 145.96661^{**}$$

$P_{.005} = 4.14$ @ 4, 60 df; 3.92 @ 4, 120 df.

IV. Significance of Mahalanobis' D^2 with the following variables:

Enrollment in grades 9-12 in high schools within the proposed area vocational school district.

Five year projected enrollment in grades 9-12 in high schools within the proposed area vocational school district.

Total population within the proposed area vocational school district.

Categories of skills needed within the proposed area vocational school district: $D^2 = 36.17407$.

$$F \ @ \ (m, \quad n_1+n_2-1-m \quad) = \frac{n_1n_2(n_1+n_2-m-1)}{m(n_1+n_2)\,(n_1+n_2-2)} \cdot D_4^2 =$$

$$4, \ (22+72-1-4) = \frac{22\cdot 72(22+72-4-1)}{4(22+72)\,(22+72-2)} \cdot 36.17407 =$$

$$4, 89 = 4.07539 \cdot 36.17407 = 147.42344^{**}$$

$$P_{.005} = 4.14 \ @ \ 4, 60 \text{ df}; \ 3.92 \ @ \ 4, 120 \text{ df}.$$

df = degrees of freedom

F = analysis of variance ratio

m = number of variables

m_1 = number of subjects in Group I

m_2 = number of subjects in Group II

P = probability

APPENDIX J

DISCRIMINANT FUNCTION CLASSIFICATION OF THE LAS CRUCES AND ALBUQUERQUE AREAS

TABLE XXXIX

DISCRIMINANT FUNCTION CLASSIFICATION OF THE ALBUQUERQUE AREA USING SIX VARIABLES

Variable	Quantiative value of variable (scaled)	Discriminant coefficient of Group I-less successful	Variable value multiplied by coefficient of Group I	Discriminant coefficient for Group II-more successful	Variable value multiplied by coefficient of Group II
Anticipated first year enrollment in an area vocational school.	410	.00034	0.13940	-.00068	-0.27880
Enrollment in grades 9-12 in high schools within the proposed area vocational school district.	1532	-.00035	-5.36375	.00010	0.15325
Five year projected enrollment in grades 9-12 in high schools within the proposed area vocational school district.	1800	-.00909	-16.36200	-.02375	-42.75000
Total population within the proposed area vocational school district.	3100	.00278	8.61800	.01193	36.98300
Categories of skills needed within the proposed area vocational school district.	10	2.64262	26.42620	2.53577	25.35770
Categories of anticipated programs offered first year in an area vocational school.	9	1.61206	14.50854	2.19971	19.79739
Subtotal			32.79377		39.26254
Constant		-10.35770	-10.35770	-13.53206	-13.53206
Total			22.43607		25.73048

Difference = 3.29441; exponential function of 3.29441 = .03688

$$P_L = \frac{1}{\sum_{K^*=1}^{g} e^{(f_{K^*} - f_L)}} = \frac{1}{1.0 + .03688} = \frac{1}{1.03688} = .96443$$

TABLE XL

DISCRIMINANT FUNCTION CLASSIFICATION OF THE LAS CRUCES AREA USING FOUR VARIABLES

Variable	Quantiative value of variable (scaled)	Discriminant coefficient of Group I-less successful	Variable value multiplied by coefficient of Group I	Discriminant coefficient for Group II-more successful	Variable value multiplied by coefficient of Group II
Anticipated first year enrollment in an area vocational school.	300	.00173	.51900	.00197	.59100
Enrollment in grades 9-12 in high schools within the proposed area vocational school district.	5650	.00028	1.58200	.00077	4.35050
Five year projected enrollment in grades 9-12 in high schools within the proposed area vocational school district.	719	-.00005	-.35950	-.00020	-1.43800
Total population within the proposed area vocational school district.	7500	-.00000	0	.00001	.75000
Subtotal			1.74140		4.25350
Constant			-0.27926		-2.27970
Total			1.46214		1.97380

Difference between score = .51166; exponential function of .51166 = .59452

$$P_L = \frac{1}{\sum_{K^*=1}^{2} e^{(f_{K^*} - f_L)}} = \frac{1}{1.59452} = .62715$$